Electrical World and Engineer

THE CONSOLIDATION OF "THE ELECTRICAL WORLD" AND "ELECTRICAL ENGINEER."

VOL. XL. NEW YORK, SATURDAY, AUGUST 2, 1902. No. 5.

ELECTRICAL WORLD AND ENGINEER

(INCORPORATED.)

114 LIBERTY STREET, NEW YORK.

PUBLISHED WEEKLY.

TELEPHONE CALL: 4044 CORTLANDT. CABLE ADDRESS: ELECTRICAL, NEW YORK.

J. M. WAKEMAN, - - - - - - - - President and General Manager.

CHICAGO OFFICE, - - - - - - - - - - - 1139 Monadnock Block.
PHILADELPHIA OFFICE, - - - - - - - - - 929 Chestnut Street.

EUROPEAN OFFICE, - - - - - - - - - - A. C. Shaw, Manager.
Hastings House, Norfolk St., Strand, London, England.

T. C. MARTIN AND W. D. WEAVER, - - - - - - - - - - Editors.
T. R. TALTAVALL, - - - - - - - - - - - - Associate Editor.

NOTICE TO READERS

WHO ARE NOT SUBSCRIBERS.

The ELECTRICAL WORLD AND ENGINEER is not returnable from the newsdealer. If you desire to purchase the paper from a dealer it will be to your advantage to notify him that you will want it, in order to insure his having a copy for you. If you wish to receive the paper regularly, please send in your subscription so that we can mail it to you direct.

Single copies are 10 cents each. The 52 copies for the entire year cost $3.00 in advance. Please send remittance with your subscription order.

ELECTRICAL WORLD AND ENGINEER.

NOTICE TO ADVERTISERS.

Change in advertisements intended for a particular issue should reach the office of the ELECTRICAL WORLD AND ENGINEER by 10 A. M. MONDAY of the week of issue. New advertisements can be received up to noon of Tuesday of the week of issue.

The first issue of each month is an export issue, having an extraordinarily large foreign circulation in addition to the regular domestic and foreign circulation of this paper.

TERMS OF SUBSCRIPTION.

United States, Canada or Mexico, - - - - - - - - - - - per year, $3.00
Foreign Countries, within the Postal Union, - - - - - - - - - - - 6.00
Great Britain and Ireland, - - - - - - - - - - - - - - - 25 shillings
Germany, - 25 marks
France, - 31 francs
Single Copies, - .10

Remittances for foreign subscriptions may be made through our European office.
In requesting your address changed give OLD as well as new address.

Copyright, 1902, by ELECTRICAL WORLD AND ENGINEER, Incorporated.

Entered as second-class mail matter at the New York Post Office.

NEW YORK, SATURDAY, AUGUST 2, 1902.

CONTENTS.

Editorial 155
The Space and Power Policy of the St. Louis Exposition. By C. T. Malcolmson 158
Visit of the Transportation Committee of the Chicago Board of Aldermen to New York City 158
The Fixation of Atmospheric Nitrogen 159
Results With Electric Canal Towage in Belgium 161
Relations of Telegraphy and Telephony 162
Telephony in Australia 163
Cross-Section of Electrical Conductors. By Thos. Griswold, Jr. 164
Telephony in Iowa 164
Wireless Telegraphy in Meteorology. By Emil Guarini 165
Improvements in Electric Transmission by Waves. By Chas. E. Fritts 169
Switchboards in the Astoria Power Plant, Long Island 171
Comment on Existing French Conditions 172
Thermo Electricity 172
The Nodon Rectifier. By P. Letheule 172
Hertzian Waves and Wireless Telegraphy. By A. F. Collins 173
New Telephone Patents 175
Meeting of New York State Independent Telephonists 175
International Tramway Union Congress in London 176
Tributes to the Memory of Mr. Mackay 177
Reported Change from Steam to Electricity of Ohio Railroad 178
Recent Progress in Electro-Chemistry. By C. P. Townsend 178
Tests of Cotton Mill Electrical Equipment 179
Disrtibution of American Exports 180
Water Power in Arizona 180
CURRENT NEWS AND NOTES 180
LETTER TO THE EDITORS:
Paralleling of Alternators. By G. Rosenberg 182
DIGEST OF CURRENT ELECTRICAL LITERATURE 183
NEW BOOKS 187
Power Development in Southern California 188
System of Calling Carriages by Electricity 188
Constant Alternating Current Transformer Panels 189
Desk Telephones 190
NEWS OF THE WEEK 191
RECORD OF ELECTRICAL PATENTS 200

UNIVERSAL CONDITIONS.

Possibly one of the reasons for the rapid introduction of modern electrical inventions and apparatus has been the universal adaptability of the new agent, rendering it easy to satisfy the purchaser the moment he is found. Of many goods it is but too true that they are salable in only one market and have to be changed for another, or indeed have to be substituted by something else; and among the duties of consular agents is that of telling shoe manufacturers or producers of hardware just how to turn out their goods so as to sell. But when it comes to electrical apparatus, little, if any, modification is ever necessary. The same style of lighting plant that does for a New York office building suits very well in a Korean palace. The same kind of trolley car that suits Chicago is good for Bangkok or Bombay. Fan motors need no "sea change" or otherwise to enable them to do their work as well in Shanghai as in Montreal. The telegraph apparatus used in Manila is just as effective in the city of Mexico; and the telephone system that meets approval in New York will be found in Tokio or Paris, in Melbourne or in London.

These universal conditions are pre-eminently in favor of export trade, and should account for the fact that even with all the manufacturing of American electrical apparatus that is now done abroad, the export this year from the United States bids fair to show up between nine and ten million dollars. We are fain to believe that even such a large amount can be greatly increased and even doubled in a few years by persistent and intelligent pushing, for the whole world is still wofully in want of electrical facilities. Moreover, the very principle referred to makes easy the immediate introduction into and utilization by the United States of any electrical novelty or new principle discovered abroad; and the rest of the world is just as keen as we are in the pursuit of the numerous new arts waiting in the near future, that will bear an electrical name.

FIXATION OF ATMOSPHERIC NITROGEN.

Of unusual interest is the report we publish this week on the fixation of atmospheric nitrogen. The mere possibility of producing artificially nitrates and nitric acid on a commercial scale is of immense theoretical interest, and even if the product should not compete on even terms with nature's output, the result would still be most notable. Nitric acid lies at the very root of chemical industry. Hardly a single branch of chemical manufacture could continue at all, let alone on a commercial basis, were the supply of nitrates cut off. Hitherto we have had to depend entirely upon the nitre beds in which, with almost inconceivable slowness, the strange microorganisms that produce nitrification have wrought the change from an inert gas to an invaluable solid. For centuries man has been drawing on the meagre nitre beds, at first slowly, and then, as civilization has grown, with reckless speed, until, if the truth were known, it would seem that the store of nitrates is in more imminent peril of exhaustion than even the coal supply. And the results of its exhaustion would be only less serious than the loss of fuel. A scientific romance of strange interest might be written around the annihilation of the nitrate supply. It might be speculated that the whole of the chemical arts would vanish; that war as we know it would be no more, for there would be an end of explosives, and when nations struggled for supremacy, sword and pike, battle-axe and cross-bow bolt would clash again on armored legions.

Doubtless, artificial culture of nitrate beds would be made to yield some commercial results, and new sources of nitrates would be unearthed, but the nitrate supply is of fundamental importance for

modern civilization. The claim of Mr. Bradley that he has worked out a practical method of drawing a supply of nitrates from atmospheric nitrogen is, therefore, of the greatest interest. Unfortunately, the article lacks sufficient details as to the power and general plant required to enable one to pass judgment on the probable cost of nitric acid produced by this method. Doubtless, the yield, at present very small, can be materially increased after some experience with the process on a large scale, and there may be here the basis of a very important industry, or rather group of industries; for it is hardly to be supposed that the method will stop with the production of nitrates. There are many useful reactions known to be produced on an exceedingly small scale by the electric spark. With Mr. Bradley's apparatus every such reaction can be carried on upon a scale capable of industrial application, so that it may be able to open up fields hitherto almost unknown, doing for gaseous raw material what the electric furnace does for solids. It is too early yet to predict the success of such methods as compared with those now in use, but even if they fail to compete with nature in nitration, they may lead to short cuts to other rarer products of great value from the purely commercial standpoint. At all events, the apparatus furnishes a new and immensely powerful engine of research, capable of startling results in theory or industry, or in both. We shall await with the keenest interest further news of Mr. Bradley's experiments, which are as interesting and promising as anything that the dawning century has yet shown.

THEORIES OF WIRELESS TELEGRAPHY.

Much discussion has appeared in our correspondence columns during the last few months as to the nature of the waves employed in wireless telegraphy. Some maintain that these are "Hertzian waves"; others that they are "sliding waves"; others, again, that they are "oscillatory currents through the earth," and still others that they are "electrostatic effects." In this issue, Mr. Collins advocates the "rectilinear propagation of free waves." We think that, in a certain sense, all these varied views are correct, and that the subject of discussion is rather a question of definition and nomenclature than of principles or phenomena.

In the first place, it should be noted that while, in free space, a Hertzian wave may be a disturbance moving at the speed of light in a straight line, like a single puff of smoke emitted from the stack of a locomotive, or a soap-bubble detached from its source and thrown into the air, yet when Hertzian waves encounter conducting substances, such as wires or conducting planes, they undergo great modification, according to the physicial and geometrical conditions of impact. They may be reflected back like billiard balls from the cushion, or be absorbed altogether; or undergo neither reflection nor immediate absorption, but take the intermediate course of skimming along the conducting surface with the wave front perpendicular thereto. Hertz studied both kinds of waves; *i. e.*, the detached kind following a rectilinear path, or what we may call the puff-of-smoke waves; and also the skimming kind, or those that run along and are guided by conductors. He showed, for example, that a resonator, formed of a circlet of wire with a minute spark-gap, would respond much farther from the oscillator, or source of electric disturbance, when a pair of parallel wires extended from the neighborhood of the oscillator to the neighborhood of the resonator, so as to form a pair of rails, along which the invisible wheels of the disturbances might run from the source to the receiver.

The theory of the experiment has always been that the waves emitted by the oscillator would naturally have advanced into free space with accompanying expansion in the absence of the wires; but when each wave struck the wires, the "Faraday tubes of force" or "lines of electrostatic displacement," or simply the "electric lines," caught hold of the wires, converged on to them at each side, and then ran along these wires at the speed of light. The lines of electric force would be in planes roughly perpendicular to the wires, but stretching from one wire to the other. The magnetic lines of displacement would be perpendicular to these or would form circles around each wire, and these invisible cobwebs of electric lines in warp and magnetic lines in woof would rush along the wires toward the receiver. The cobwebs would be prevented from expanding and weakening; for, neglecting absorption into the substance of the wires by reason of imperfect conductivity, the cobwebs would travel unchanged, and undiminished, for an indefinite distance. Consequently, the lines of magnetic force would cut the resonator loop, with sufficient density to induce a spark impulse therein, at a much greater distance from the source than when the parallel wires were removed. It is unfair to Hertz, therefore, to say that Hertzian waves are waves disconnected from conductors, or free-space waves only. Besides, we do not live in free-space, but on the earth, and to restrict Hertzian waves to pure nonconducting regions is, in a certain sense, to banish them from our presence and consideration.

In the case just considered of the waves between parallel wires, studied by Hertz, the phenomena are in all known respects the same, so far as the wires are concerned, as when electric discharges or oscillations take place around a conducting circuit formed by the wires. In other words the same series of waves and the same geometrical cobweb structure of electric and magnetic lines, could be produced in and round the wires by substituting for the oscillator in their neighborhood a Leyden-jar connected to the wires, and producing from them into the wires a certain definite series of oscillating discharges. The wires in the presence of the oscillator would become the path of true oscillating electric currents, which would have been communicated to them by "electrostatic induction" from the oscillator. The ideas and phraseology of the pure wave student thus merge into the ideas and phraseology of the student of electric currents in wires. It would be idle, therefore, to discuss whether in such a wire-wireless arrangement the waves were strict Hertzian waves between the two parallel wires, or whether they were oscillating currents in the wires. Both contestants would be right. A complete statement of the phenomena would include both the waves in the ether and air around the wires, and the oscillating currents in the wires themselves.

Next considering a Hertzian oscillator in free space remote from all conductors, it is evident, by symmetry, that if we take the axis of the initial spark discharges, or the line joining the induction-coil knobs, as origin, the waves will be emitted symmetrically with respect to the midplane, perpendicular to this line, half-way between the knobs. Whatever positive electric force, or electricity, or displacement, exists at one side of this infinite plane, in any wave or series of waves, must also exist at the same instant as negative force, electricity, or displacement at the corresponding point on the other side. The waves on each side of this plane will be a plane counterparts of each other. Moreover, this plane will be a plane of zero potential, being half-way between the positive and negative sides. But by a known general theorem in electricity, which becomes self-evident on due reflection, any such zero equipotential plane may be occupied by a perfectly conducting surface without disturbing anything. Inserting the conducting surface, or supposing the plane to become perfectly conducting, we immediately have two complete distributions of waves, one between the positive side and the midplane conductor, and the other between the negative side and the same midplane, to match. Either of these distributions may now be extinguished or suppressed at will without disturbing

the other, because no disturbance can be transmitted through a perfectly conducting surface. If we suppress one side, say the negative, and keep the positive side at work, we have a unilateral complete Hertzian system of waves, no longer in free space, but between free space and a flat conducting sheet, which sheet carries oscillating-current waves, as we ordinarily understand that term.

The vertical antenna of wireless telegraphy is the active side of such a unilateral Hertzian oscillator. The other side, its image underground, is imaginary. The waves emitted from the real antenna run out into surrounding space just as they would on the corresponding side of a complete double-oscillating system in free space. Only the comparison is imperfect because the earth's surface is not a perfect conductor, and consequently the distribution above ground is disturbed by this fact. The feet of the running electrostatic lines get entangled in the incompletely conducting ground surface, burrow deeper, carry energy in, and get expended, thereby weakening the distribution overhead. At sea, on a surface of better conductivity, there is less disturbance of this kind. Moreover, the waves bend over the earth's convex conducting surface, just as they bend around turns in conducting wires. If the earth's surface were perfectly conducting, the oscillating currents in the surface would be of infinitesimal depth, but of great intensity. With lessening superficial conductivity the oscillating currents go down deeper into the earth, with diminished local intensity or amperes per square inch.

It seems, therefore, unnecessary to discuss whether wireless telegraph waves are electromagnetic waves in the air and air-ether, or are oscillating currents in the earth's crust. They are both. One phenomenon cannot occur in a unilateral Hertzian distribution without the other. The student with his gaze bent on the earth will see nothing but the oscillating currents below. The student gazing above, will see nothing but the waves chasing each other overhead. The main fact arrived at by all the co-operative scientific and practical work of the last century is that when a "current flows in a conductor," there must be electric waves in the environing insulator; and conversely, although waves may run through insulators indefinitely with displacement currents only, as distinguished from conducting currents; yet, when waves run near conductors the conductors have electric currents in them.

THE ALLEGED FALLACY OF THE SECOND LAW OF THERMODYNAMICS.

We have so frequently seen the second law of thermodynamics impugned, that the outcry surprises us no more than the populistic slogan of "Down with the Trusts." Yet both the Trusts and the Second Law of Thermodynamics are still doing business. The second thermodynamic law has been variously expressed by different writers, but it includes the fact that no heat engine can yield mechanical work except by taking in heat at a higher temperature and rejecting heat at a lower temperature; or, in other words, by virtue of an established difference of temperature. This is as axiomatic to the theory of heat engines, as difference of level is to the hydraulic motor. Just as the water motor can only do work by allowing water to descend from an upper level to a lower, from a higher pressure to a lower, or from an up source to a down sink, so the heat engine must have its upper temperature source and its lower temperature sink of heat. A water motor would be impotent in an ocean of water without a difference of level. A heat motor is powerless in a world of heat without a difference of temperature. Uniformity, like *ennui* to the soul, is collapse to the heat engine.

The enormous importance of this innocent-looking law to human beings is apparent when we consider that when the sun's heat has once warmed all bodies in a given vicinity to practically the same temperature, no engine can yet be conceived of which can turn any appreciable part of that heat into work. The surrounding air and water and solids may all be hot, and possess abundant stored-up heat energy, capable of being reckoned in foot-pounds, and yet because these bodies are all equally hot, none of this heat, none of these foot-pounds, can be converted into mechanical power. Any heat engine, to be practicable under such conditions, would have to be big enough to reach out, either to a hotter place, or to a colder place, to an upper or to a lower temperature. When a solar heat engine works, it is because some substance is locally raised by the sun's heat to a higher temperature than the surrounding bodies, and a portion of the heat in flowing from the hot level to the surrounding level of temperature is converted by the engine into mechanical work. If it were not for the law, millions of hp-hours of energy in the oceans of air and water on our world stored from the sun's heat might be available for driving man's machinery.

Of course, the hypothetical heat engines which could extract the heat energy out of, say, ocean water, might be uncommercially expensive to operate, supposing that the second thermodynamic law were repealed, in which case humanity would not be benefited by the repeal. But if this were not so, and the imaginary heat engines were cheap to make and work, the repeal of the second law, the removal of this temperature-difference limitation, might perhaps be worth more to the civilized world in money value than all the existing wealth of nations put together. The total stock of solar heat energy in the materials on the surface of our planet, now unavailable by reason of a substantial uniformity of temperature, might, if made available, make coal worthless rubbish, and give mankind enormous resources in power. In science there is no penalty attached to heresy. In fact, much scientific advance has often been made by heretics in science. But the heretics were supported by facts and observations, and were able to demonstrate the soundness of their positions, after which the science was modified, while heresy and orthodoxy changed places. Consequently, no man is to be blamed for refusing to believe in the second thermodynamic law. But it is the duty of all recalcitrant heretics to make good their doctrines by sound evidence before they seek to proselytize.

We have before us a pamphlet purporting to have been presented before the recent meeting of the American Association for the Advancement of Science, entitled "The Fallacy of the Second Law of Thermodynamics, and the Feasibility of Transmuting Terrestial Heat into Available Energy." This paper boldly stands for the feasibility of converting terrestrial heat into mechanical work without any difference of temperature. It does not claim that there is any existing engine which works on this plan. It merely describes a theoretical heat engine, for which, by a fallacious process of reasoning, this result is claimed. The same reasoning would, under slightly modified conditions, involve the production of mechanical work without any absorption of heat energy whatsoever, *i. e.*, would contravene the conservation of energy, as well as the second thermodynamic law. The fallacy is the old one of a working substance alternately in the gaseous and liquid conditions, and is avoided when the entropy-temperature diagram is substituted for the volume-pressure diagram. A paper of this sort is liable to produce much trouble and distress, because, being couched in scientific phraseology and purporting to have been presented before a scientific body, it might be regarded as unimpeachable by business men inexpert in thermodynamics.

The Space and Power Policy of the St. Louis Exposition.

By C. T. Malcolmson.

No exposition worthy of the name has depended on the receipts from space and power rentals to achieve even a financial success, and a financial success is among the last things an exposition should aim for. Success, like office, will more often come to worth than to the chronic candidate. Economy, prudence and conservative business principles must be observed, but if pure money making constitutes either the expressed or concealed purpose of an exposition then it is fore-doomed to failure. The amusement features and the fakirs are always ready to pay more money for space and facilities than exhibitors can afford and an alleged exposition conceived and operated as a money making scheme becomes a midway with an exhibit annex, and the annex is thickly sprinkled with fakirs to the annoyance and disgust of legitimate exhibitors.

In the interests of success, an exhibition should be run for exhibitors almost by exhibitors, so sensitively in touch ought to be the management with the exhibitors. An International Exposition to succeed must be organized and operated on the very broadest lines of intelligent public policy, else it will fail to realize the cause for its being—the collection and exhibition of objects which will practically illustrate the resources and the arts and industries of the world as they exist at the period of the exposition. Everything must be done to attract the support and good will of every nation and of every art, craft and industry, and nothing must be done to excite suspicion or reasonable criticism, and above all every act must be performed as if it were to be later subjected to the fullest scrutiny before the bar of public opinion. In addition to all this the exposition must have abundant capital, since to prepare and present even a compendium of the present state of the world requires the outlay of a vast amount of money—very much more than can be had from private subscriptions alone.

Through the generous and wise provision of congress and the approval of the President, $5,000,000 have been added to the $10,000,000 already raised for the St. Louis Universal Exposition by the city and citizens of St. Louis and large appropriations have been made for specific exhibitions by our National Government, by foreign governments and by states and corporations. It is estimated that when the gates of this Exposition are opened in 1904, a sum of over $40,000,000 will have been expended on buildings, utilities, decorations and amusement features, and that the exhibits will represent an additional value of over $100,000,000.

In what has been stated will be found the reasons which actuate the management in abolishing charges for space and for facilities. By this statement it must not be understood that the Exposition will give space, power, light, etc., in unlimited quantities to all who ask, for it will do none of these things. It will charge no exhibitor for space(none can be bought at any price), and it will make no charge for such facilities as it deems necessary for the operation of any exhibit, but it will select from the applications those which promise best to illustrate the natural resources of the world and the achievements of mankind. To those selected, such space and facilities will be allotted free, as in the judgment of the executives the circumstances warrant and the most interesting presentation of the subjects demand. If exhibitors feel that for display purposes they require more light or power, their demands will be satisfied at a reasonable and uniform rate.

The intent and purpose of the management of the Universal Exposition of 1904 may be gathered from noticing that all of the exhibits departments have been organized and in operation for over seven months, that practically all of the exhibit buildings are planned, that many of them are in course of construction, and that no building for any other purpose has been planned nor the ground for its site definitely selected, and that even the general location of the midway has not yet been determined. Clearly, it is to be business first and amusement afterwards in this exposition; as wise an axiom for exposition practice as it is for a well-ordered life. The city which does the most business draws the best amusements, and the combination attracts the greatest crowds. The exhibits constitute the business feature of an exposition, and these being distinctly worthy, the serious and the idle will alike pay their money at the gates, since within there is profit or instruction or recreation for all, for each as he elects. Herein, and herein alone, is the logical hope for a Universal Exposition's success—in its genuine worth commanding universal attention.

Visit of the Transportation Committee of the Chicago Board of Aldermen to New York City.

The broad subject of a complete reorganization and improvement of the local transportation facilities of Chicago has been under consideration for some time by the authorities of that city. An extended report of the committee on local transportation, of the Chicago aldermen, which went very thoroughly into the relations of the city with the railway companies, and which outlined the steps to be taken in the opinion of the committee, was presented to the mayor last December. Briefly, the report recommended a unification of the downtown terminals so that an interchange of traffic between the principal surface lines could be effected, and the introduction of a subway, by which the congestion on some of the downtown streets could be reduced by the removal of the railway lines to below the surface. This plan was approved by Mayor Harrison last January in his message to the city council, in which he also made further recommendations, which, if carried out, will demand a complete reorganization of the transportation system of the city. Realizing, however, that before taking any radical action in the direction of one plan or another it was advisable to investigate the transportation situation in other cities, the city authorities decided to send a delegation consisting of its committee on local transportation to make a study of what was being done in the East. The cities selected included New York, Boston and Washington, and the purpose of the committee was to interview the gentlemen who have been prominent in the development of the transportation lines in those cities, and to decide upon a policy which would be suitable to the needs of a city the size of Chicago, and which would combine the best experience in subway and other construction relating to transportation, which had been secured in the cities to be visited.

The committee on local transportation includes some of the leading and most successful business men in Chicago, and consists of Frank I. Bennett, chairman, and Messrs. M. I. Foreman, Charles Werno, E. F. Herrmann, H. W. Butler and H. F. Eidmann, lawyers; F. D. Connery, Wm. Mavor and Thomas Carey, prominent contractors; W. J. Raymer, John Minwegen and W. T. Maypole, manufacturers; and W. S. Jackson, of the Chicago Board of Trade.

These gentlemen reached New York on Thursday, July 24, directly from Chicago. On Friday, July 25, they examined the Manhattan Railway system. In the afternoon, at the invitation of President Greatsinger, of the Brooklyn Rapid Transit Company, they took a trip in a special car over the lines of that company, visiting the power station and other points of interest. On Saturday, a visit and tour of inspection was made of the construction work of the Metropolitan Street Railway Company. On Monday, July 28, the committee called on William Barclay Parsons, chief engineer of the Rapid Transit Subway, and later made an inspection of the City Hall terminal of that road, now under construction, and visited other parts of the work. On Monday evening they were entertained by James H. McGraw, president of the McGraw Publishing Company, at a dinner at Sherry's, at which President H. H. Vreeland and Assistant General Manager Root, of the Metropolitan Street Railway Company; Contractor John B. McDonald and Chief Engineer Deyo, of the Rapid Transit Subway, as well as others, were present. On Tuesday morning the committee left New York for Boston.

The committee is being accompanied on its trip by Bion J. Arnold, who, as recently stated in these columns, has been appointed consulting electrical engineer and transportation expert of the city. Mr. Arnold's reputation as an electrical engineer is well known, and he was recently engaged by the New York Central Railroad Company to draw up a system of recommendations for the electrical equipment of the Park Avenue line of that company by electricity. Mr. Arnold has associated with him in the work on which he is now engaged for the City of Chicago a number of the leading experts on transportation matters in the country, including Oren Root, Jr., assistant general manager of the Metropolitan Street Railway Company of this city; Charles V. Weston and George C. Sykes, of Chicago, and a number of others.

Apart from some discourteous articles which appeared in several of the New York papers in regard to the purpose and standing of the committee, the visit to New York was very successful, and the delegates expressed themselves as deeply gratified with the treatment accorded them by the local transportation managers and engineers, and as satisfied with the information secured during their visit.

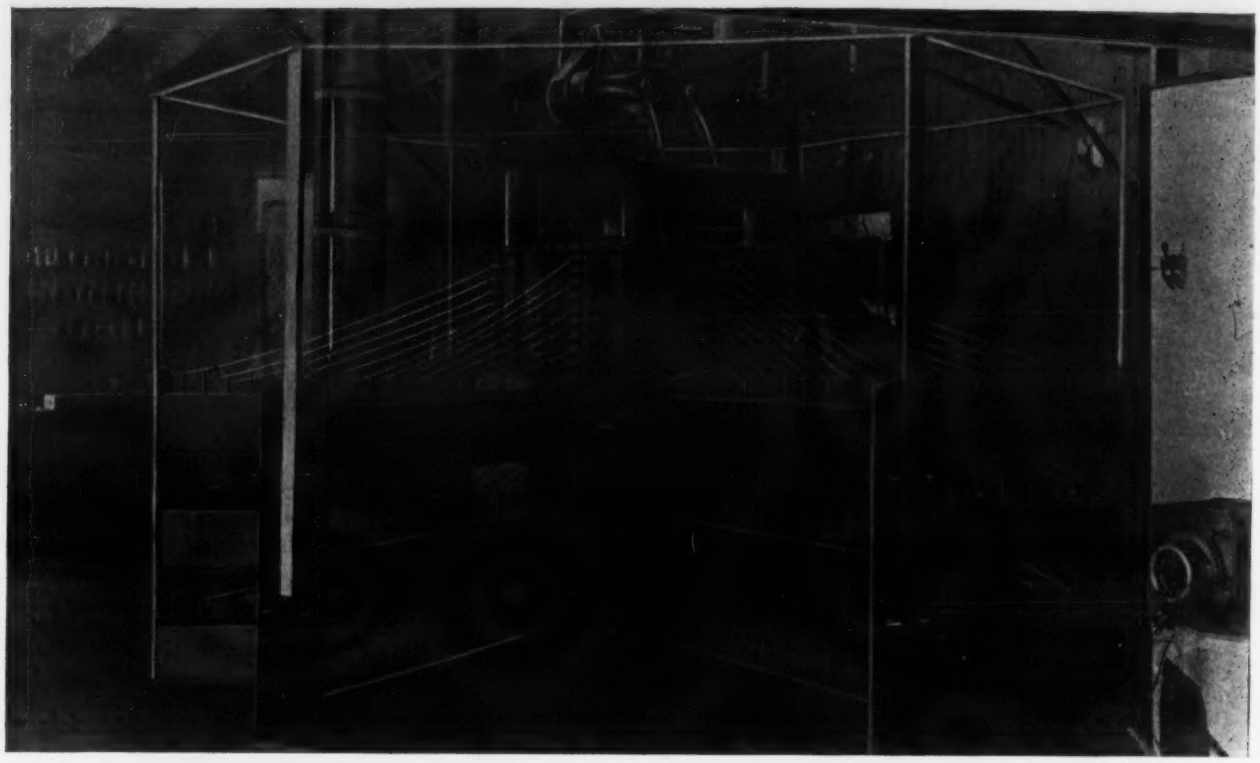


FIG. 1.—PROCESS OF ELECTRICAL FIXATION OF ATMOSPHERIC NITROGEN, NIAGARA FALLS, N. Y.

The Fixation of Atmospheric Nitrogen.

The Atmospheric Products Company, of Niagara Falls, is developing what promises to be an electrochemical application of extraordinary importance. The enterprise was referred to in an Institute paper, read this spring by Mr. L. O. Jacobs, and has been recently brought into public prominence by the interest which Lord Kelvin in his recent visit to America displayed in, and the comments which he made on, the process in question.

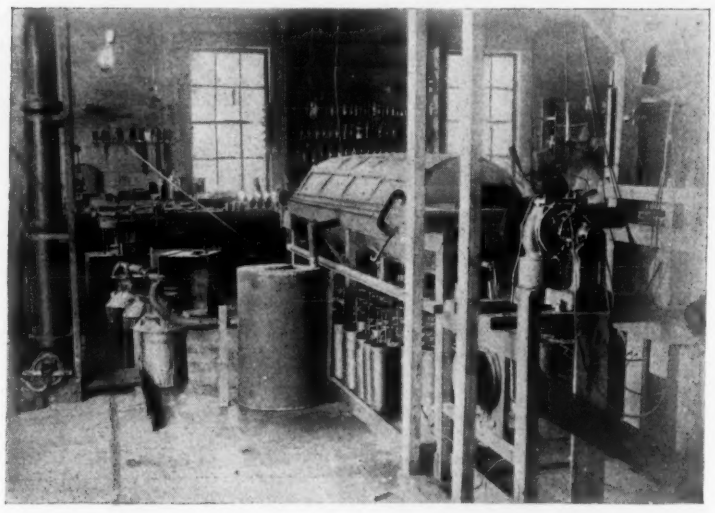


FIG. 2.—EARLY EXPERIMENTAL APPARATUS.

The basic principle of the process depends upon phenomena discovered more than one hundred years ago and admitted as a fact of academic interest only. In 1785 Priestly discovered that when an electrical spark was discharged through air, the air immediately surrounding the same underwent a chemical change. This phenomenon is familiar to all who have had to do with electrical machines that produce sparks or arcs. After such a machine has worked for a time, a pungent odor is noticed, which has often been ascribed to the closer union of oxygen atoms producing ozone. While it is not impossible that such a reaction may take place, it now seems probable that the pungent odor which obtains in the neighborhood of an electric spark is due for the most part to oxides of nitrogen.

Air, it will be remembered, is a mixture of about two volumes of oxygen to eight of nitrogen, and the electric spark causes the oxygen and nitrogen to unite, forming *NO* or nitric oxide, and NO_2 or nitrogen peroxide. Of course, the nitric oxide and the nitrogen peroxide thus encountered in ordinary experiments have been in very minute amounts, and no one seemed to think it worth while to investigate how much nitric oxide may be produced from a given amount of power, and whether or not the production of these gases could be made a commercial process, until Mr. Charles S. Bradley took up this problem in 1899. He associated himself with Mr. B. R. Lovejoy, and together they reviewed all that has been done with reference to the investigation of this phenomenon, and then set to work to design machinery to produce these oxides on a commercial scale by means of the electric spark.

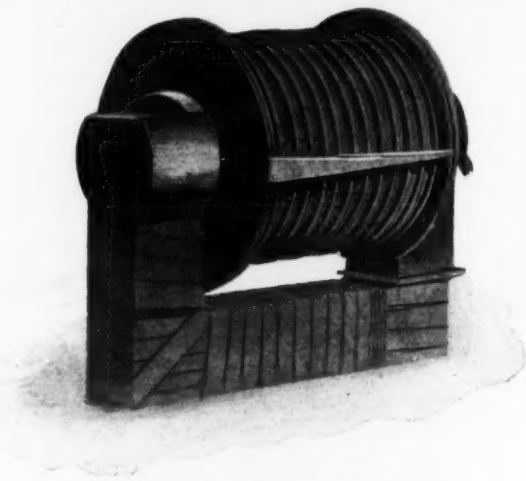


FIG. 3.—INDUCTANCE COIL.

The system very naturally developed into the production of a large number of arcs in a confined space, through which a regulated volume of air is passed, Fig. 5. This air emerges from the apparatus laden with nitric oxides and peroxides, which are conducted away and utilized in forming the important commercial compounds of which more will be said later on. The Bradley-Lovejoy investigations soon showed that a static spark was not very effective in

producing the desired result, and a great deal of money was spent in finding out just what form of electric spark would produce a maximum chemical union of nitrogen and oxygen in the air. Alternating and direct-current arcs of different voltages were tried, and the result has been emphatically in favor of the high-voltage, direct-current arc. It has been found best to use a voltage of about 10,000 and allow it to jump electrostatically through the air a short distance, thereby establishing the arc, and then rapidly separating the contacts until the arc breaks.

To produce this power, a different character of machine from any yet made was necessary, and to provide a machine for their immediate needs, Mr. Bradley took a large direct-current series arc machine and rearranged its circuits to suit his purposes. This machine is shown in Fig. 4. The fields are separately excited, and the arcs are connected in multiple with the terminals of the machine. In each arc circuit is placed an inductance coil, Fig. 3, which is carefully adjusted for best results. This prevents the arc forming a short-circuit on the machine; and as the motion of the arc drawing contact is exceedingly rapid, the load of an arc drawn in this way is very light indeed. One of the inductance coils is shown in Fig. 3.

The machine shown in Fig. 4, readapted, as noted in the foregoing paragraph, is capable of operating a Bradley-Lovejoy device making 414,000 arc per minute. The device itself, shown in Fig. 5, consists of a box of metal provided with openings to admit the air and properly circulate it, and containing rows of fixed contacts. Each of these contacts is insulated with great care and to each is connected a wire passing first to an inductance and thence to the positive pole of the dynamo. The negative pole is a revolving cylinder equipped with properly spaced projections which come very near but do not touch the fixed contacts in the surrounding box. A diagram of the electrical connections is shown in Fig. 6. This cylinder is driven by a vertical electric motor at 500 revolutions per minute; and as

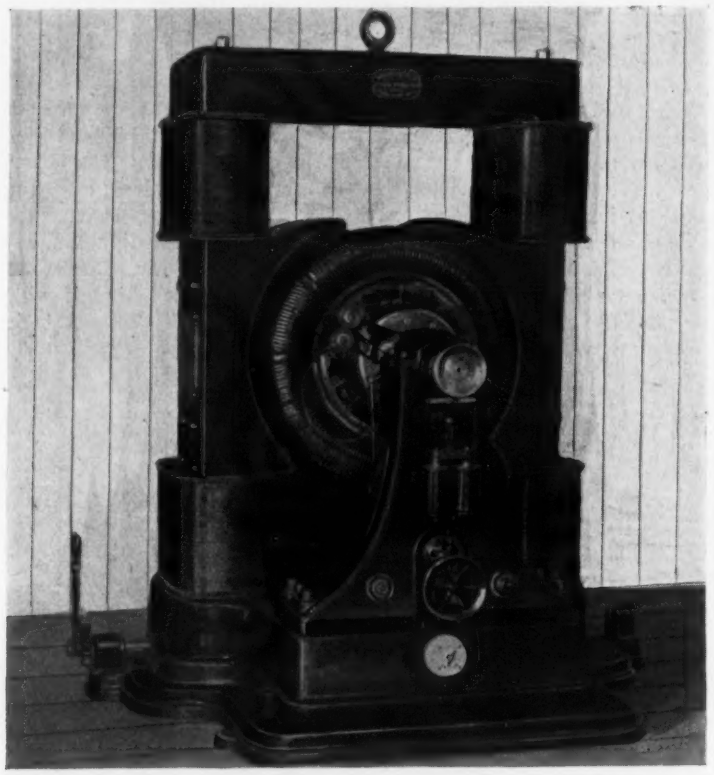


FIG 4.—SPECIAL GENERATOR.

there are six sets of contacts in line with the fixed contact on the wall of the cylinder, each fixed contact therefore provides 3,000 arcs per minute. The air is driven through the apparatus at the rate of about five cubic feet per arc contact per hour. In the apparatus shown in the figure there are 138 contacts, six rows of 23 each. It may be well understood that the exact voltage, the correct amount of inductance, the number of breaks per minute, and the arrangement of the contacts with reference to the air circulation, and last, but not least, the proper state of the arc, are matters which involved an infinite amount of careful investigation.

The air passing from this machine emerges laden with 2½ per cent. of oxides of nitrogen, and by simply leading these gases through water in sprinkling towers well known to chemical processes, there results nitric and nitrous acid. The latter rapidly evaporates and recombines with water again, the result being that ultimately all of

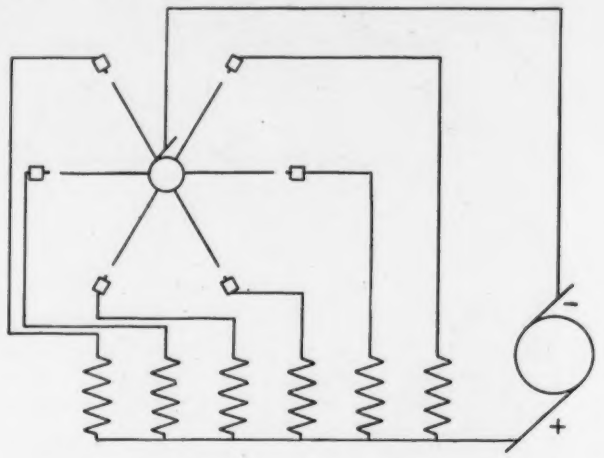


FIG. 6.—DIAGRAM OF CIRCUITS.

the fumes are converted into nitric acid. If these gases are brought into contact with caustic potash, $K\ O\ H$, saltpetre, $K\ N\ O_3$, is the result; and if brought into contact with caustic soda ($Na\ O\ H$) nitrate soda $Na\ N\ O_3$ is the result. In fact, it is easily possible to form almost any of the nitrates by this simple combination with appropriate bases. When it is remembered that the nitrates form one of the most important classes of chemical reagents, it will be readily

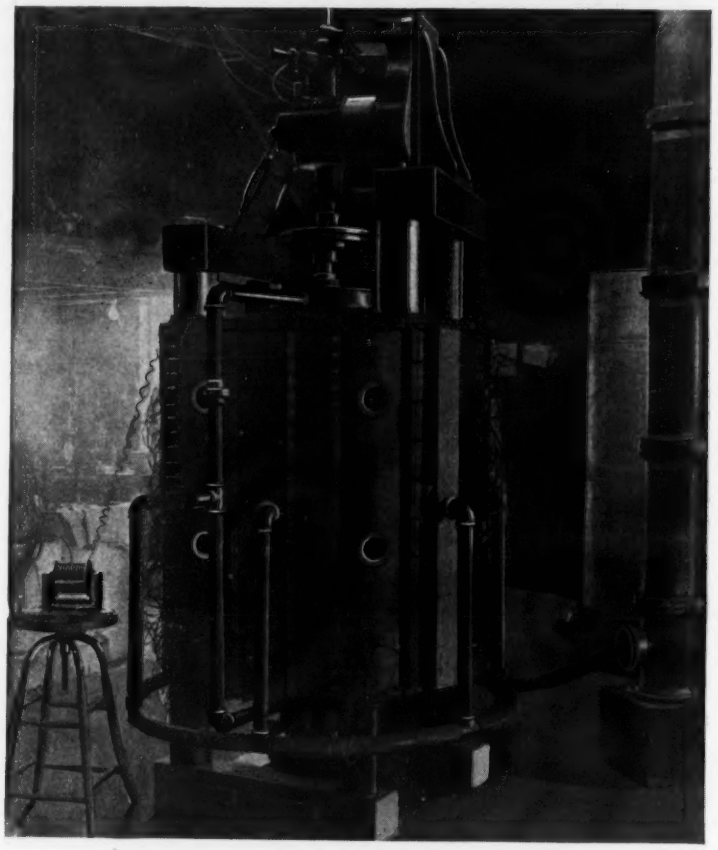


FIG. 5.—APPARATUS STRIPPED.

seen that this process reduced to one of commercial profit will be one of the most important developments of the period.

Over one million tons of nitric acid are manufactured every year by treating natural nitrates with sulphuric acid, and as the promoters of this enterprise claim that they can produce the same product at figures which will control this business, this field alone makes the enterprise of the greatest importance, especially as the nitric acid thus produced is chemically pure, which is by no means the fact with commercial nitric acid to-day.

The nitrogen compounds have heretofore been made only by trespassing on the fixed nitrogen in combination as found in nature. That is to say, if nitric acid is to be made, nitrogen in combination

must be taken from the earth in the form of Chili saltpetre and distilled with sulphuric iacd. The nitric acid thus formed disappears in the arts and in a thousand ways is made practically unrecoverable as a fixed nitrogen compound; and, consequently, as we have been for years taking from the earth a most important compound which is limited in supply. Upon these compounds, namely the fixed nitrates, vegetation of all kinds depends, and some of the far-seeing scientists have stated that very shortly nature will cease to honor these drafts upon her fixed nitrates—that twelve million tons a year of fixed nitrates will be required to bring the wheat crop in 1930 up to the amount required. These are serious matters, and, therefore, it is very important that means be sought to produce fixed nitrates without drawing on nature's reserve supply, by utilizing the free nitrogen in the air around us. This has been the object of Messrs. Bradley & Lovejoy, and long before the time the extraordinary necessity for large quantities of fixed nitrates develop it is expected that the process will be on a sufficient scale to enable it to meet the problem successfully.

Results With Electric Canal Towage in Belgium.

About two years ago attention was directed in these pages to a system of electric canal haulage installed in Belgium, for which it seemed good results might be expected. The subject is one of considerable importance for any country possessing an extensive canal system ,and hence there need be no surprise at the frequent efforts made to bring canal methods up to the level of other improved transportation systems, by the adoption of electric power. The results now reported from Belgium by one of our staff contributors afford much encouragement as to the future of work in this still unoccupied department of electric power and traction.

FIG. I.—A SUB-STATION.

The company operating the system is the Societé de Traction sur les Voies Navigable, who adopted the plan of M. Leon Gerard, the well known Belgian electrical engineer. The present installation is used on a canal between Brussels and Charleroi, which has a length of 50 miles. Three-phase currents at 6,000 volts are generated. The line has two circuits of bare conductors; three primary wires for 6,000 volts, and three secondary wires for 600 volts; every three miles there is a 36-kw transformer. By means of a triple trolley the current is supplied to the 5-hp, 6-pole, 3-phase motors on the tractors. A leather pinion, with 12 or 16 teeth, is fixed to the axle of the motor and drives a shaft, on which there is a clutch, with which it is possible to drive a chain connected with the driving axle or with a conical winch on the other side. The extra power gained by the use of the winch is of great service at certain times. Each tractor runs only over its own section of ground; it can draw five boats, each laden with 70 tons, at a speed of a little over two and one-half miles an hour. In places where the pathway is too narrow to admit of passing, the tractors simply exchange boats and return on their own road. For passing through towns where the river banks are covered with warehouses, or in going through crowded locks, electric tugs or launches are used. The company supplies electricity also for lighting and motor purposes to the villages in the neighborhood, there being eleven communes along its lines.

The main generating plant visited comprises three dynamos of Brown Boveri design, delivering 15 amperes at 6,000 volts. The transformers receiving the current for canal work are of the same make; while those for lighting and distribution are Schuckert. The total output is 30,000 kw hours per day for lighting and power. The charges on the canal are 19 centimes per kilometer for hauling an empty boat, and the cost for an average fully loaded boat of 70 tonnes figures out 38 centimes per kilometer. It is stated that the charge made for hauling a loaded boat by horses is 39 centimes. The charge made by the company for lighting is 55 centimes per kw-hour, and for motive power, 25, 20, 18 and 15 centimes, according to different conditions. The lighting current is reduced in the sub-stations

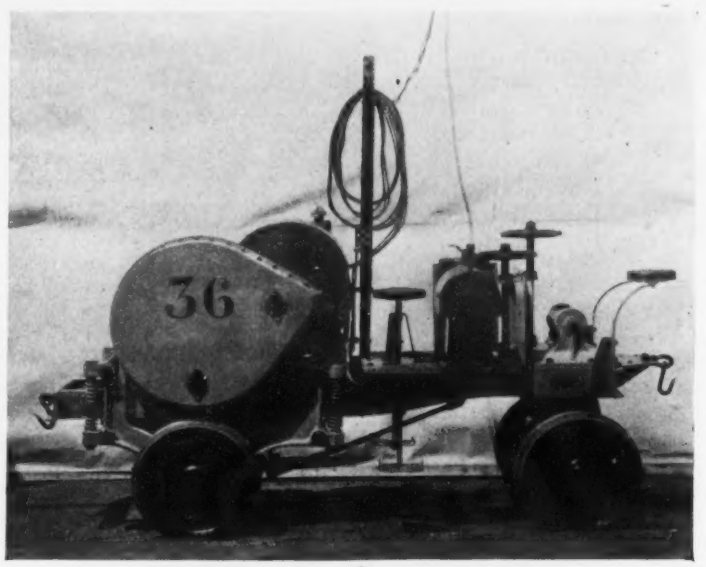


FIG. 2.—MECHANISM OF TRACTOR, LATEST TYPE.

or transformers' houses by separate transformers to 220 volts.

One of the sub-stations to which canal current is delivered every 4.7 kw is seen in Fig. 1. Side and front views of tractors in active service are shown in Figs. 3 and 4, with the three trolley conductors delivering current to the three-phase motor on the tractor. Fig. 2 is a view of a tractor stripped, showing the operative parts as explained above. Each tractor has

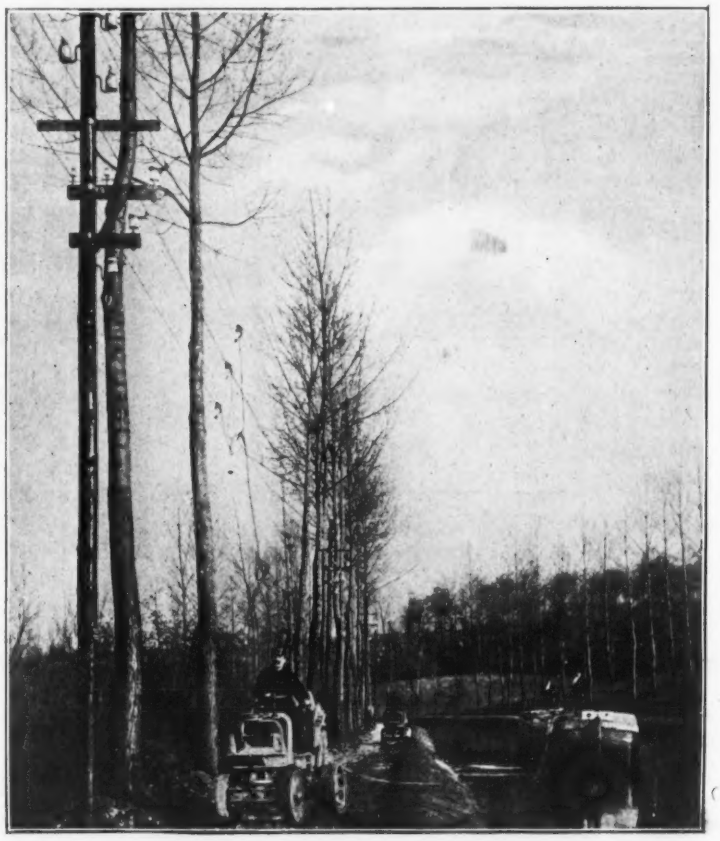


FIG. 3.—TRACTOR TOWING TWO CANAL BARGES.

been proved to be powerful enough to haul from 4 to 5 boats, but the Belgian government, for some reason or other, connected probably with fears of disintegration of the bank by the effort of the tractor or the "wash" of the boats, does not allow this. Hence the boats are hauled singly, which is a more expensive method, especially as regards the item of labor. The

motor car wheels are 70 cm. in diameter, and have a tire 20 cm. broad. The trail wheels are 16 cm. in diameter, and have a tire 15 cm. broad. The wheels last about a year. All wheels are mounted on ball-bearings.

It appears that the cost to the company per boat kilometer was as follows:

1900 fourth quarter	fr.	0.206
1901 first quarter	"	0.233
" second quarter	"	0.132
" third quarter	"	0.112
" October quarter	"	0.106
" November quarter	"	0.116
" December quarter	"	0.125
1902 June quarter	"	0.120

This includes simply station charges. From April 1, 1901, to April 1, 1902, the company did a business of 127,721.5 empty boat kilometers and 359,067.9 loaded boat kilometers. The company has sixty tractors, of which 45 are now in regular service, and there are 6 of the electric tugs for use within city limits. Coal, by the way, costs the company 14 to 15 francs per tonne, delivered.

The company has been hampered in its development of the system from the fact that the government owns the canals and the tow-paths, and will not keep the latter in good condition. It is also slow about giving the company facilities for the extension of its service. The tow-paths are sprinkled with broken stone where the tracteurs run. The commercial speed of hauling is 4 kilometers per hour, including the passage through the bridges. The speed with horses is between 1.9 and 2 kilometers per hour. Each tracteur covers a distance of about 3 to 4 kilometers, when the boat is transferred to another tracteur. Boys are used for running the tracteurs, and they work about 14 hours a day.

From the last annual report before us, of 1901, it would appear that the receipts for haulage were 131,000 francs, as compared with 167,400 francs in 1900, a difference due to an interruption

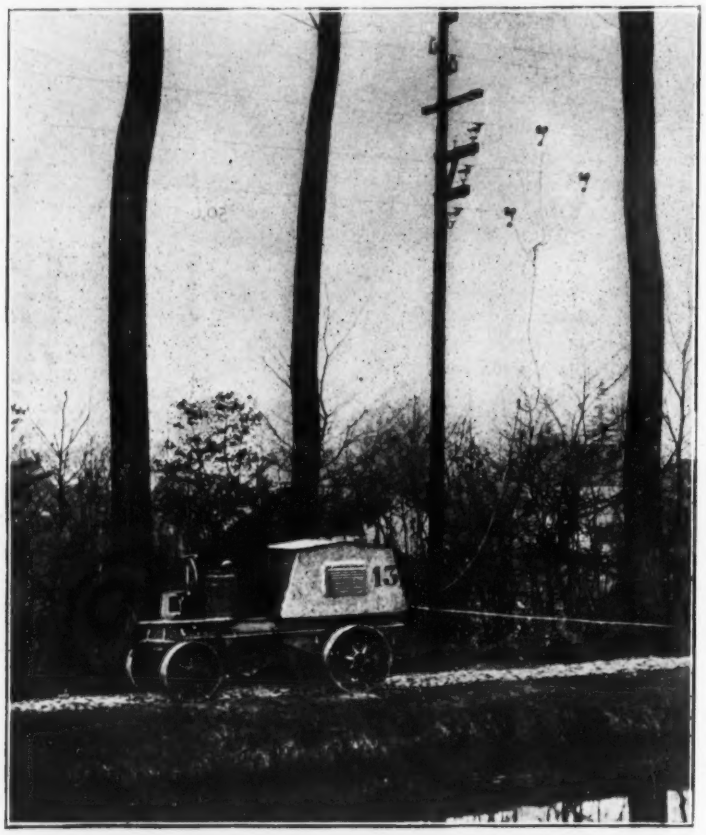


FIG. 4.—SIDE VIEW OF TRACTOR ON TOW PATH.

of 62 days while structural repairs were being made by the department of roads and bridges, and partly to the memorable strike at the Antwerp docks. The loss of traffic is estimated at 85,000 francs. On the other hand, the auxiliary revenue from lighting and stationary motors rose from 75,000 francs to 79,000 francs, and is still increasing. The company had reckoned on a service of 5,000 lamps or their equivalent, but has reached 6,000, and expects now to connect up at least 8,000. The company started in 1898 with a capital of 1,200,000 francs, and began work on Christmas Day, 1900, in distributing current from

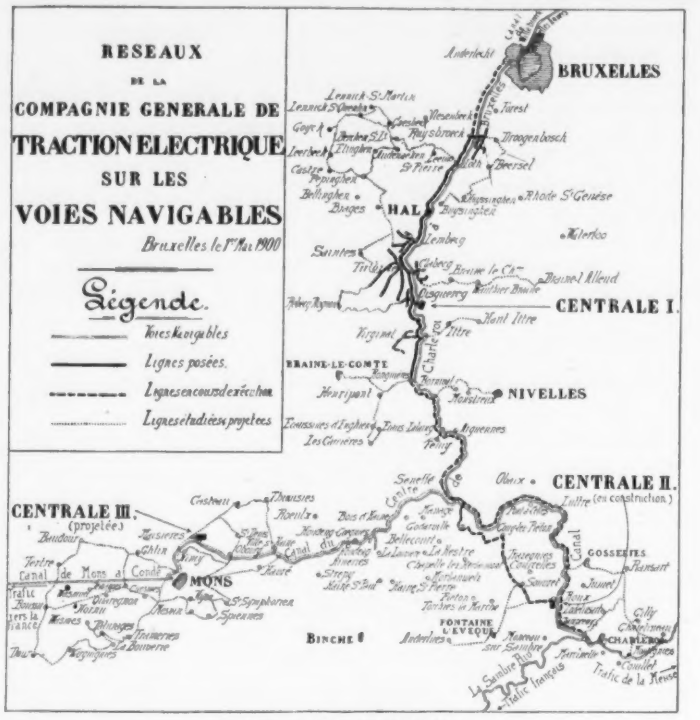


FIG. 5.—MAP OF REGION.

its central station at Roux. It now has a second generating plant at Oisquercq, the first in Belgium where polyphase alternators, driven by steam engines, have been put in parallel, and the capital account has been increased to 2,977,513 francs, while it holds now no fewer than 37 communal concessions, opening the way to further canal work, as well as considerable incidental supply for light and power from at least three central plants.

Relations of Telegraphy and Telephony.

In a recent discussion of the Western Union situation and of telegraph property as an investment, the *Boston News Bureau* remarks: "Formerly between two cities in Massachusetts 40 wires were humming with Western Union messages; to-day 40 telephone wires are doing the business, and two telegraph wires could take care of all the telegraph messages between those two cities and yet the Postal Company is there dividing what little telegraph business there is left. The Western Union compared with the telephone system is a stage coach in comparison with the railroad.

"A few years hence the American Telephone and Telegraph Company will be in a position to do what little telegraph business is required in this country at a minimum cost as a mere incident of the telephone business. At present the Telephone Company is having its hands full with the construction of new lines to meet the demands of its enormously expanding business.

"Nearly one-half the population of the United States is in cities, and this means that in the future more than one-half the people of the United States will be within easy reach of the telephone, and this one-half will be the active half of the population, and the people who use the telegraph will be a decreasing number.

"The Western Union Company is laden with such leases and water-soaked capital as to make impossible to consider an enlargement of itself into the telephone field, while the Bell Telephone system of the country is doubling and quadrupling all the telegraph lines. The Telephone Company has not only a telephone system paying expenses and a fair interest upon the construction cost, but it has a telegraph system at absolutely no cost, and which is now unused, for you can telephone and telegraph on the same lines at the same time without interference. It has, furthermore, the great necessary adjunct of the telegraph service—a messenger system, for the collection of dispatches, and this messenger system is its 1,500,000 telephone stations in the United States."

Telephony in Australia.

A government report of nearly 200 closely printed quarto pages, containing the deliberations, investigations and recommendations of a committee of the Australian Post and Telegraph Department, appointed to inquire into the condition of the telegraph and telephone systems of the states of the commonwealth, gives some interesting information regarding the status of telephony in Australia, and the proposals for the reconstruction and development of the telephone systems of the commonwealth. The committee was instructed to make a thorough inquiry into the existing systems of telephony, with a view to submit recommendations aimed at the removal of defects of construction, maintenance, working and management. Under "construction," all branches of a telephone system were to be dealt with, and the preparation of standard specifications for all material and necessary works was included. Under "management" was included the vexed question of telephone rates. The instructions to the committee advised that "in dealing with the whole subject as well as with the detailed objects thus placed before the committee, it must be remembered that the principal objects to be attained are: greatly increased efficiency as compared with the existing systems and greater economy in construction, maintenance and working, together with the largest measures of uniformity available."

The committee, consisting of Sir Charles Todd, K. C. M. G., deputy postmaster-general and superintendent of telegraphs, South Australia; Mr. J. Y. Nelson, chief electrician, New South Wales; Mr. H. W. Jenvey, chief electrician, Victoria, and Mr. J. Hesketh, electrical engineer, Queensland, carried out its work in a very thorough manner, holding sittings both in Melbourne and in Adelaide, making thorough investigations of the existing telephone systems in Melbourne, Brisbane, Sydney and Adelaide, and securing full reports on the telephone systems of Victoria, New South Wales, Queensland, South Australia and Tasmania from the officers in charge. In 1899 and 1900 Mr. T. Howard, assistant electrical engineer of the department, made a tour of the world to investigate telephone conditions in the United States and Europe, and his report and evidence were of great value to the committee in arriving at the recommendations made in the report. Mr. Arthur Williamson, the representative of the Western Electric Company, also gave highly useful evidence regarding the various features of the common battery system.

The committee as a result of its deliberations on the reports and evidence presented recommended the adoption of the common battery system for large exchanges, *i. e.*, exchanges of over 2,000 lines. For smaller exchanges, the bridging system was deemed adequate to meet the conditions. The complete reconstruction of the telephone systems of the three larger cities, Sydney, Melbourne and Adelaide, is recommended. The Sydney system, including suburban exchanges, had, at the time the report was made, 8,555 stations connected, with a spare capacity in the switchboard of but 290 lines. The existing switchboard had been in use but 18 months, but for various reasons the committee recommended its abandonment in favor of a complete common battery system, at an estimated total cost, including the necessary alterations to the central office building, of $234,000. In recommending the adoption of the common battery system, the committee was much exercised over the question of subscribers' instruments, as the cost of new instruments for every subscriber's station adds so largely to the total cost of the change. It was recommended that if possible the existing instruments be converted into common battery sets. The reconstruction of the Sydney system, recommended by the committee, involves also an expenditure of $186,000 for new outside work, and $45,000 for new switchboards for the smaller central offices, making a total expenditure of $465,000, to be spent at the rate of about $155,000 a year, for three years.

For Melbourne, an even more thorough and complete scheme of reconstruction is recommended than for Sydney. The present overhead wire distribution is to be replaced by a complete underground system, starting with a tunnel from the central office. The tunnel will run about 1,200 yards through the center of the city and from it, with branch conduits in various directions, to carry the cables along the different routes to the distributing points. Underground conduits are to be built even out to various suburban points. The main central office is to be equipped with a common battery switchboard, having a present capacity of 5,000 lines and an ultimate capacity of 10,000 lines. The existing system at Melbourne comprises about 3,100 lines with 1,800 extension stations. The total cost of the extensive reconstruction recommended is about $1,132,000, of which $777,000 is for tunnel conduits and cables, $150,000 for the exchange equipment, $120,000 for subscribers' instruments, $50,000 for alterations to the central office building, and $35,000 for labor and supervision. The expenditure is to be spread over three years, about $320,000 being allotted to the first year, $410,000 to the second year, and $402,000 to the third year. The report says that the committee appreciates the magnitude of the expenditure recommended, but points out that the whole of the Melbourne system requires immediate and complete attention if a satisfactory service is to be given. No part of the work recommended can be omitted without marring the whole scheme. It is not practicable to take any half measures, and it is impossible to stand still.

For Adelaide, an underground distribution system and a new common battery exchange are recommended, at a total outlay of $450,000, the expenditure to be spread over three years, as in the other cases.

The committee points that its drastic recommendations for reconstruction might lead to the inference that the selection of telephone systems in Australia had originally been ill-advised and the construction bad, but this is not really so. The systems adopted were, at the time, standard throughout the telephone world. What was done in Australia was being done in all other countries, and the action now recommended is likewise the action necessary not only in Australia, but necessary and being taken in every system of importance elsewhere. For example, in the annual report of the American Bell Telephone Company for 1900 occurs the following: "In the larger exchanges the old type of multiple switchboards is fast being replaced by relay boards equipped with electric lamp signals and central battery plant installed in buildings specially designed for the purpose and owned by the companies." So that the work recommended for Australia is only another illustration of the universal telephone habit of rebuilding, and incidentally an application of the national motto—"Advance, Australia!"

As regards underground work, cables, conduits and so forth, the recommendations of the committee followed American practice pretty closely, as it will have been seen they do in regard to central office equipment.

In long-distance work, little is done in Australia. In New South Wales the longest line is that between Sydney and Bathurst, 155 miles; in Victoria, between Melbourne and Bendigo, 102 miles; and in Queensland, between Brisbane and Warwick, 155 miles. Some of the lines pay well and others do not, taking into account the loss of telegraph revenue caused by their competition. The committee recommends the construction of a line between Sydney and Melbourne, 625 miles, at a total estimated cost of $250,000, using 30-foot poles and 600-lb. copper wire. Taking the working capacity of the line at 70 three-minute conversations a day, the line, if it were used to the extent of half its full capacity, would yield an annual revenue, at a rate of $1.62 for three minutes' use, of $17,060 a year, or a profit of $3,810 over the estimated working expenses of $13,250. In estimating the probable revenue, the committee have adopted the most disadvantageous view of the expected business in order that they may be on perfectly safe ground in recommending the construction of the line. The fact is referred to, in considering the probable effect on the telegraph revenue, that the establishment of a telephone line between large cities creates business which did not previously exist, while it has almost always followed that the telephone receipts steadily increase year by year. The Australian long-distance rates are based on the English rates, the tariff for three-minute conversations being as follows: For a distance of 25 miles or less, 12 cents, the rates rising by 6 cents for each additional 25 miles. The public station rate for a local message is 6 cents.

The committee went very thoroughly into the subject of rates, and emphatically endorsed the message rate system, recommending a scheme of message rates, which is not to be introduced, however, until the reconstruction of the principal exchange is sufficiently advanced to cope with the increase of subscribers expected to result from the adoption of message rates. The existing rates in Australia are all flat, ranging from $45 a year for business service in Melbourne and Sydney to $30 a year in smaller places. Mileage is charged on lines extending over a mile from the exchange; in some cases the mileage charge applies to lines over half a mile long, but the one-mile radius is the usual practice. Having discussed fully the existing Australian rates and the practice regarding telephone rates followed in other countries, the committee declared in favor of the message rate or toll system, being of the opinion that "the

most equitable system of charging is that which makes a fixed annual charge to each subscriber to cover interest and sinking fund on the average capital outlay, together with a minimum number of free calls, and an additional charge for each call beyond the minimum." The committee further pointed out that "the fixed charges should vary with the mileage and with the size of the exchange within certain limits, seeing that the average capital outlay per subscriber varies with the length of the line and is greater with a large than with a small exchange. It must also be remembered that the value of the service to a subscriber on a large exchange is greater than that on a small one."

The scheme of rates recommended by the committee comprises a minimum rate dependent on the size of the system, the minimum rate including 300 calls. Additional calls up to 1,000 are to cost 2 cents each, from 1,000 to 5,000 1 cent each, and from 5,000 upward ½ cent each. The minimum rates are for exchanges up to 5,000 lines, $22.50; for exchanges from 5,000 to 20,000 lines, $25, and for exchanges of over 20,000 lines, $30. At these rates 1,800 calls a year, say six a day, will cost, in a 5,000-line system, about $48, a little over the present rate. The present average daily traffic per line in Melbourne and Sydney is between 13 and 14. There are some lines, having a very large use. One line sent 163 calls in a day. Another gave a daily average of 103 for six days, and another, in Brisbane, gave a daily average of 86 for ten days.

The reasons for recommending the adoption of the message-rate system in place of the present flat rates are summarized in the report as follows: (1) The committee are convinced of the impossiblity of giving a thoroughly satisfactory service in any large exchange, with the existing rates of subscription and an unlimited number of calls, without an increase in the operating and working expenses out of proportion to the present revenue. (2) Unnecessary conversations are avoided. (3) Subscribers pay amounts proportional to the use they make of the system. (4) The service is improved by the reduction of unnecessary calls, and, therefore, of the frequency with which lines are reported "engaged." (5) The service would be further improved by the calls to be answered by each operator being reduced.

Cross-Section of Electrical Conductors.

By Thos. Griswold, Jr.

THE total annual cost of using electrical conductors may be taken as the sum of the watt and interest losses. The yearly investment loss per 1,000 feet of conductor is expressed by the equation,

$$l = fkw, \tag{1}$$

in which w is the weight of conductor per 1,000 feet, k the cost per lb. erected, and f is the assumed combined rates of interest, depreciation, taxes, etc.

The annual watt loss per 1,000 feet of conductor is expressed by the equation,

$$L = 8.76\, nKI^2R, \tag{2}$$

in which R is the resistance of 1,000 feet of conductor, I is the curruent, K the cost per kw-hour, and n the percentage of time the conductor is used.

Taking D as the diameter of the conductor in mils and m and p as constants,

$$R = \frac{m}{D^2} \tag{3}$$

$$w = p\, D^2 \tag{4}$$

Substituting (3) and (4) in (1) and (2),

$$l = fkpD^2 \tag{5}$$

$$L = 8.76\, \frac{nKI^2m}{D^2} \tag{6}$$

then,

$$l + L = fkp\, D^2 + 8.76\, \frac{nKI^2m}{D^2} \tag{7}$$

For a particular value of D, $l + L$ will be a minimum. Differentiating (7), equating to zero, transposing and eliminating,

$$fkp\, D^2 = 8.76\, \frac{nKI^2m}{D^2} \tag{8}$$

which expresses the conditions determining a minimum value of $l + L$. By comparing (8) with (5) and (6) it will be seen that the total annual loss is least when the investment and watt losses are equal.

From (8),

$$D^2 = I\sqrt{\frac{8.76\, nKm}{fkp}} \tag{9}$$

For copper of 97 per cent. conductivity and 8.93 sp. gravity, at 75° Fah.,

$$p = .003041, \tag{10}$$

$$m = 10832. \tag{11}$$

For aluminum of 61 per cent. conductivity, 2.68 sp. gravity at 75° Fah.,

$$p = .0009129, \tag{12}$$

$$m = 17223. \tag{13}$$

Substituting these values of m and p in (9) and distinguishing the two metals by their chemical symbols in subscript, we have,

$$D^2_{Cu} = 5586\, I\sqrt{\frac{nK}{fk}} \tag{14}$$

$$D^2_{Al} = 12856\, I\sqrt{\frac{nK}{fk}} \tag{15}$$

These last two equations give the circular mils cross-section, in the use of which for the current I the annual loss will be the least.

By putting $I = 1$, we have,

$$D^2_{Cu} = 5586\sqrt{\frac{nK}{fk}} \tag{16}$$

and,

$$D^2_{Al} = 12856\sqrt{\frac{nK}{fk}} \tag{17}$$

Equations (16) and (17) give the circular mils per ampere for least loss.

Since the corresponding increments of l and L in (7) are of opposite sign, small variations in D^2 produce even smaller variations in $(l + L)$. For this reason the use of a commercial size cable or conductor nearest to the theoretical size given by the formulas will entail an annual loss but slightly in excess of the theoretical least loss.

For bus-bars, straps and bare work generally the formulas will be found to give current densities well within the insurance rules. With cheap power and high interest charges, expensive circuits and limited periods of use, results should, of course, be checked with the insurance rules and tables of safe carrying capacities.

Telephony in Iowa.

It is stated that over 600 telephone companies in the State have made reports to the State auditor. The largest is the Iowa Telephone Company, of Davenport, the Bell Company, with 15,942 telephones connected. The Mutual, of Des Moines, reported 1,938 telephones. Other big companies reported as follows: Cedar Rapids and Marion, 1,668; Cedar Valley, of Waterloo, 1,603; Ottumwa, 1,043; Marshall Telephone Company, 663; Greene & Western, of Mason City, 1,040; Dubuque, 1,000; Standard, of Waukon, 1,354; Western Electric, of Mason City, 701; Northern Iowa, of Cresco, 642; Nebraska, of Omaha, 934; Musses Bros., of Atlantic, 336; Mississippi Valley, of Keokuk, 273; Martin Telephone Line, of Webster City, 300; Hawkeye, of Perry, 758; Hawkeye, of Belle Plaine, 860. But few of the companies report large mileage of wire. The Cedar Valley has 688 miles, the Green and Western, 327, the Mississippi Valley, of Keokuk, has 273, and the Vinton and Benton, 263.

Wireless Telegraphy in Meteorology.

BY EMILE GUARINI.

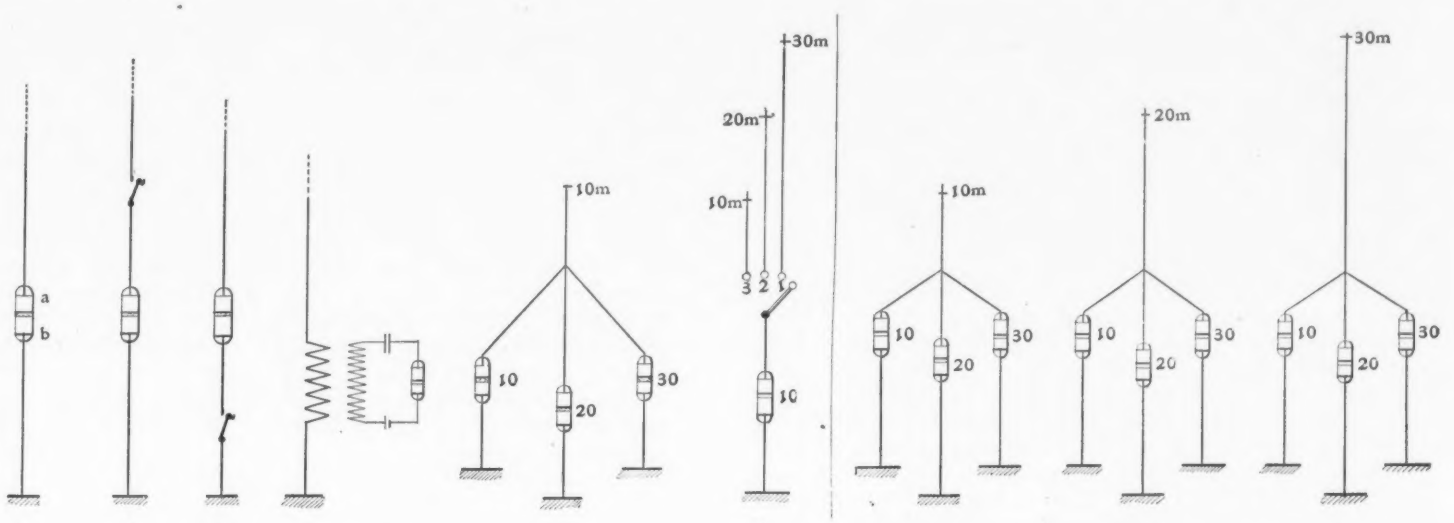
SINCE wireless telegraphy passed from the laboratory to the practical stage, means have steadily been sought to eliminate the disturbances produced by atmospheric electricity in the receiving apparatus. While these disturbances do not prevent transmission they are none the less annoying, since they require that the signal intervals be lengthened beyond what would be necessary if such disturbances did not occur.

It is well known that the difference of the potential between a point in the atmosphere and the earth is very variable, both with respect to time and to different places. Assume that Fig. 1 represents an antenna connected to earth through a coherer. The difference of potential between the coherer at *a* and *b* depends upon the difference of potential between the earth and the upper terminal of the antennæ. If this difference of potential is sufficient, that is to say, if it exceeds the critical tension of the coherer (we follow Prof. Blondel in using the term "critical tension," which expresses the minimum tension under which the coherer will become conductive), the latter becomes conductive, and the apparatus which it actuates (a galvanometer, a bell or a register operated, for example, from a relay) will register a signal. Sometimes when in normal condition the coherer is not influenced, but, as was proved in the Brussels-Maline-Antwerp experiments,[1] if there is a break either between the antenna and the coherer (Fig. 2), or between the coherer and the earth (Fig. 3), it is influenced.[2] The writer and Lieutenant Poncelot attributed this to an atmospheric current traversing the antennæ from the peak to the earth; this current would be insufficient to actuate the coherer normally, but it will actuate it when through an interruption of the circuit extra currents are set up.

It is known that when the weather is calm the potential of the air is always positive, and that it increases in value about in proportion with the height from the earth. It will thus be seen that there may be disturbing effects if, as some experimenters consider necessary, long vertical antennæ are employed, the length increasing with the distance between stations.

There are several means of diminishing the untoward effects of atmospheric electricity on wireless telegraph receivers of the imperfect contact form. Thus, for example, very short antennæ may be employed, points avoided, or a coherer employed of only medium sensitiveness, that is to say, having a low critical tension. But the means which up to the present seem to be the most efficacious against atmospheric electricity is that employed by Mr. Marconi. That is to say, instead of connecting the antenna directly to the coherer, it is connected to the primary of an induction coil, in the secondary of which is the coherer and a condenser (Fig. 4).

Let us consider for an instant what occurs with this disposition. The direct grounding of the antennæ permits the continuous flow of atmospheric electricity. This phenomenon[3] was observed at Wimereux in signaling across the English Channel, in 1899; one day during a storm it was possible to draw sparks from the antenna when its end was disconnected from the apparatus; but as soon as the end was reconnected to the primary of the induction coil, no effect was produced at the receiver, which acted as well as ordinarily. However, when there was a significant variation in the potential of the antennæ (which depends on the variations in the potential of the peak of the antennæ, and especially that of the earth when the latter, which ordinarily is negative, becomes positive, as when it rains), there is induction in the secondary coil and the coherer will be influenced. Thus, for example, in experiments[4] which the Marconi International Marine Company made between Antibes and Biot, April, 1901, notwithstanding the arrangement of Fig. 4 was used, it was possible, especially during the warm hours of the day, to register parasitic currents that at times attained a strength which interfered with communications.



FIGS. 1 TO 6.—COHERER CIRCUITS. FIG. 7.—MULTIPLE COHERER CIRCUITS.

Moreover, the receiver is influenced when lightning occurs within a certain range, but it should be remarked that lightning and brusque variations of potential at the extremities of the antennæ only occur at infrequent intervals, and thus transmission is not interfered with any more than in the case of ordinary telegraphic and telephonic transmission.

There are physicists, however, and already quite a number, who are working along lines quite different from those of Marconi and others, namely, meteorological physicists. Instead of endeavoring to protect receiving apparatus from the influence of atmospheric disturbances they seek not only to make evident and record such effects, but to do so over the greatest possible distance. Wireless telegraph apparatus may thus serve to detect and record atmospheric electrical phenomena in normal weather, and also to register thunder strokes, and consequently the course of a storm.

Though not much progress has been made in the way of applications, following are some examples: Referring to Fig. 5, suppose there are connected with a single antenna having, for example, a height of ten meters, three coherers, the critical tensions of which are 10, 20 and 30 volts, respectively. These three coherers, which are at the same distance from the two terminals of the antennæ, are grounded, either directly or through relayed bells having different tones, or through registers indicating hours. If the difference of potential between the top of the antennæ and of the earth is greater than 10 volts and less than 20 volts, the receiver 10 will be influenced, while with higher voltages either the receiver 20 or the receiver 30 will be actuated, the latter, of course, at all voltages greater than 30. The fact is not of importance that the other two receivers are actuated at the same time as the receiver 30. Besides, it would not be difficult to make arrangements whereby when the relay of receiver 30 is actuated the other receivers would be locked; this could

[1] Electrical World and Engineer, April 3, 1901.

[2] *Electrical Review*, London, July 12, 1900, page 43.

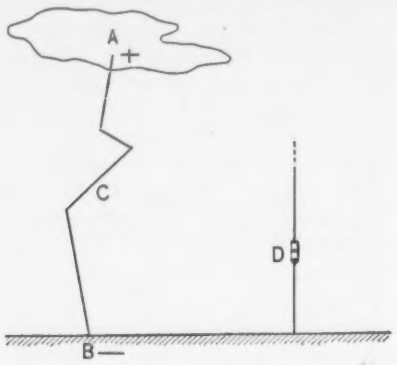
[3] Les Ondes Electriques et La Telegraphie Sans Fil, by J. Boulanger G. Ferrie.

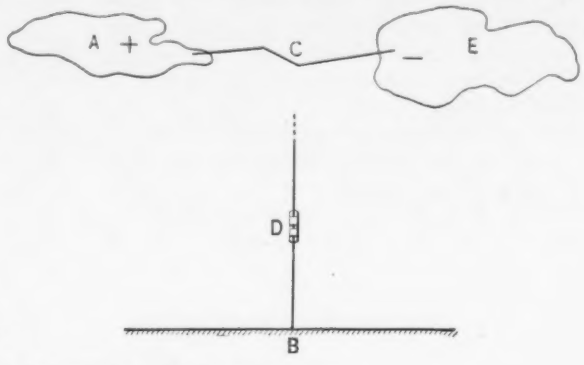
[4] *Eclairage Electrique*, July 26, 1901.

be done by placing the armature stop of relay 30 in series with the registers 10 and 20. By making use of a larger number of instruments, one would be enabled to construct diagrams giving curves of difference of potential between the earth and a point situated at a definite altitude.

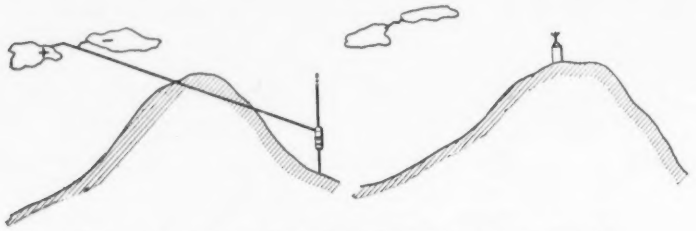
Let us next examine the arrangement of Fig. 6. In this case there is a coherer having a critical tension of 10 connected on the one side to earth and the other to the arm of a three-point switch, the points of which are connected, respectively, to three vertical antennæ of different lengths, namely, 10, 20 and 30 meters. Now move the arm over the points until the coherer is actuated. Suppose, for example, that the coherer is actuated when connected with point 2. It will then be known that at a certain instant the difference of potential is 10 volts at an altitude of 20 meters.

Fig. 7 represents a combination of the arrangements of Figs. 5 and 6. Here there are several coherers of different critical tension, each connected to an antennæ of different length; that is to say, there are three coherers having critical tensions of 10, 20 and 30 volts, respectively, one being connected with an antennæ having a height of 10 meters, the other to an antennæ having a height of 20 meters, and the third to an antennæ having a height of 30 meters. It is possible with such an arrangement to obtain indications wherewith to construct curves of the difference of potential at different heights.





FIGS. 8 AND 9.—ARRANGEMENTS FOR THUNDER STORMS.



FIGS. 10 AND 11.—ARRANGEMENT FOR THUNDER STORMS.

The applications to registering thunder storms are more limited, but present a greater interest, since they enable us to obtain data pertaining to the state of the atmosphere within a given region, and even enable us to follow the progress of a storm; that is to say, to know with some degree of approximation if a storm will visit a certain place. In the case of hail storms, this is under some circumstances of the utmost importance.

Referring to Figs. 8 and 9, suppose that at a certain instant the difference of potential between the cloud, *A*, and the earth, *B*, (Fig. 8), or between the cloud, *A*, and another cloud, *E* (Fig. 9), is sufficient to give rise to a discharge, *C*, in the direction *A* toward *B*, or *A* toward *E*; a vibrating movement is then produced in the ether, and the receiver *D* will be actuated. As to the distance over which storms can be signalled by such an arrangement, this depends upon the height of the antennæ, on its surface, on the elevation where it is erected, on the strength of the atmospheric discharge, on the distance of the latter from the apparatus, and the height at which it is produced.

Referring to Figs. 10 and 11, suppose an obstacle is interposed between the coherer and cloud, as, for example, a mountain top, the transmitting distance is then, as in the case of wireless telegraphy, greatly diminished. If an antenna 6 meters high is situated on an elevated point (Fig. 11), from which the horizon can be seen, this distance is at least 60 miles.

It is sufficient to register the hour and the number of discharges to construct a diagram such as that of Fig. 12, which gives the number of lightning discharges registered in the month of July by apparatus in the observatory of the Technical Institute of Girgenti, which will be described further on. If it is the desire to follow the courses of a storm, the following arrangement may be used: From what has been said before, it is easily seen that as long as the storm is a great distance from the apparatus only the electrical waves produced by the more powerful discharges reach the apparatus at an intensity sufficient to influence the coherer. As a consequence, it is only at long intervals that the bell is operated. As, however, the storm approaches, the intensity of the waves increases and the apparatus is actuated at shorter intervals. When the storm is near or over the place, the bell is in continual operation. When the bell rings at comparatively long intervals the prospects are that a storm will arrive in some hours. As the intervals become progressively shorter the storm either is increasing in strength or approaching. If the number of signals should then commence to decrease progressively, it would signify that the storm is receding or decreasing in strength.

MM. Popoff, Tommasina, Poggio Lera and Lancetta are those to whom credit is particularly due in connection with apparatus for registering thunder storms. The apparatus of M. Popoff, professor of the Naval School at Cronstadt, Russia, consists (Fig. 13) of a coherer in a circuit including a battery and a relay; another circuit contains a bell, and the relay contact is in shunt with the first at the binding posts of the battery. The hammer of the bell is so arranged that it can strike the coherer at each vibration. A graphic record is obtained by means of a Richard register mounted in shunt with the bell. To avoid the effect of sparks at the bell and relays, the coherer is surrounded by a double metallic case, in which there is a narrow slip that allows the electric waves to enter.[5]

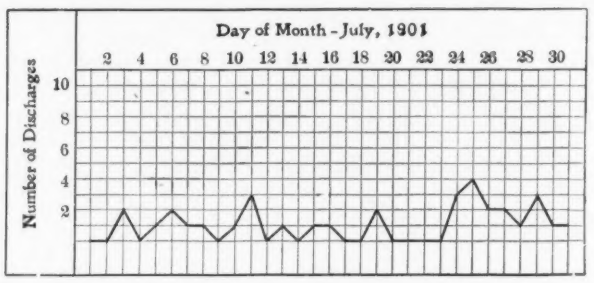


FIG. 12.—DIAGRAM OF DISCHARGES.

M. Popoff was the first (in 1895, that is to say, before the first Marconi patent, which was filed in England, June 2, 1896) to construct a complete and practical receiver on the imperfect contact system to detect electromagnetic waves. He employed his arrangement first to register thunder discharges, and afterwards in the transmission and reception of wireless telegraph signals; the details of this latter work, however, have not been published. M. Popoff connected one of the extremeties of the coherer to a lightning rod, or simply to a metallic wire on a long mast, the other terminal of the coherer being put to earth (Fig. 14). This constituted an arrangement possessing all of the essential parts of a wireless telegraph system, namely, coherer, antenna, earth connection, relay, tapper and recorder. The operation of the apparatus is evident. At each series of waves produced by the lightning the coherer is affected—to a greater extent if an antenna is employed—

[5] *Voisenat, Annales Telegraphiques*, March-April, 1898.

the relay apparatus operates, the register records a point, and as the hammer of the bell taps the coherer everything is returned to a normal state.

Prof. Thomas Tommasina, of the University of Geneva, as early

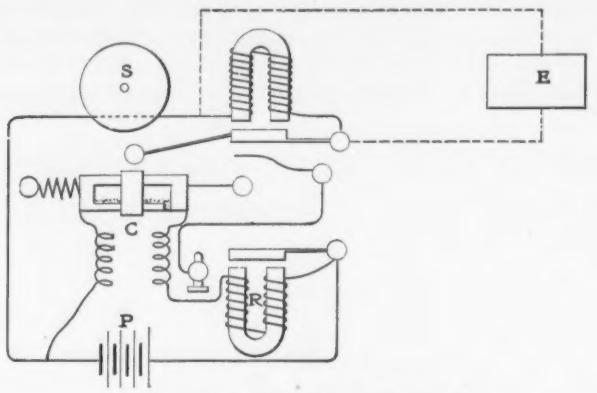


FIG. 13.—POPOFF ARRANGEMENT.

as 1898 (publication made Jan. 5, 1899, in a communication to the Société des Sciences Physiques et Naturelles de Genéve) experimented with a very simple apparatus, consisting of a coherer connected on the one side with an antenna and on the other side with

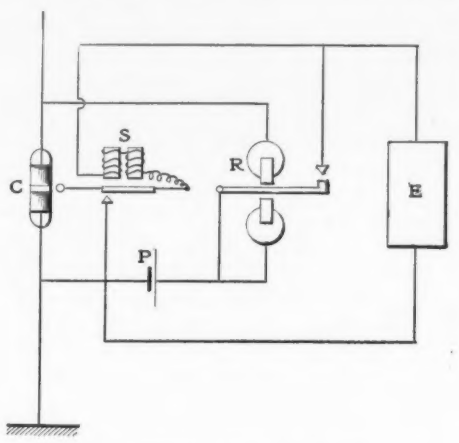
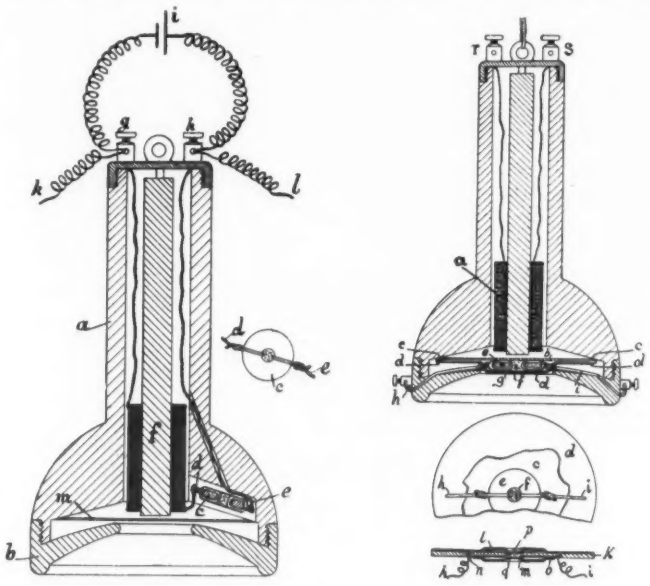


FIG. 14.—POPOFF ARRANGEMENT.

the earth in series with a battery and a telephone, the coherer being inserted within the telephone. Sometimes Prof. Tommasina used filings coherers, in which case the telephone diaphragm took the place of a tapper (Fig. 16), but more often the telephone was sup-



FIGS. 15 AND 16.—TOMMASINA TELEPHONE COHERERS.

plied with a carbon decohering coherer without any metallic contact (Fig. 15).

Referring to Fig. 16, *a* is the telephone coil; *b*, telephone diaphragm; *c* and *d*, insulation; *e*, coherer insulation; *f*, filings cavity; *g*, mica sheet; *h* and *i*, coherer electrodes; *k*, insulating membrane; *l*, iron plate; *m*, filings; *n* and *o*, silver plates; *p* and *q*, mica, and *r* and *s*, telephone terminals. A photographic view of the telephone-receiver is shown in Fig. 17.

The electro-radiaphone, as the apparatus has been called by Prof. Tommasina, not requiring adjustment is very adaptable for making observations on the progress of distant storms. There are required only a single cell of dry battery and some exterior wires, which may even be placed horizontally; but it is necessary to have great care as to the insulation of the ends of these wires, which constitute the receiving antennæ.

Prof. Tommasina has made many observations, both at Intra, on

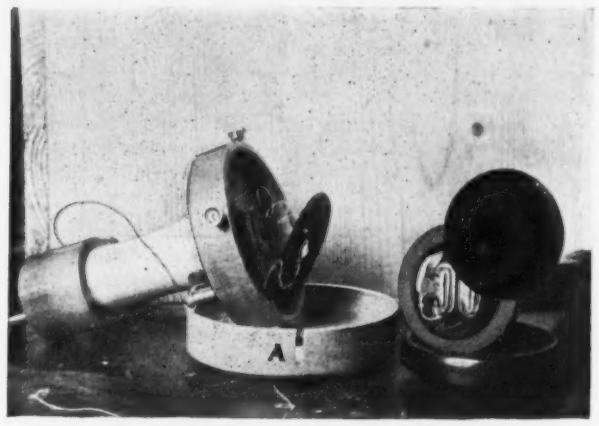


FIG. 17.—TOMMASINA TELEPHONE RECEIVER.

Lake Maggiore, in Italy, and at his laboratory near Geneva, in Switzerland, and he has found that the electro-radiaphone gives forth a number of sounds, which together produce the illusion that one has been transported to the vicinity of the storm and is following it in all of its phases.

The laboratory of Mr. Tommasina has an elevation of only six meters above the ground. The receiving antennæ (Fig. 18) consists of three copper wires; outside of the window through which they pass, these wires are spread out and extend over a roof terrace open on all of its sides. The exterior end of the three wires, terminated in rubber tubes, are secured to paraffine glass insulators, both inside and on the masts, thus preventing the final four meters from becoming wetted by rain. The insulators are 12 feet from the earth and two meters distant from each other; each wire is 30 meters long. In the laboratory the circuit is grounded on water pipes, and finally, in order to avoid all danger both to persons and apparatus, when the storm is near at hand connection is broken both with the earth and with the aerial wires, which are then insulated at both ends. A telephonic receiver in the office and one in the bedroom, together with a signal bell, enable Prof. Tommasina to follow day

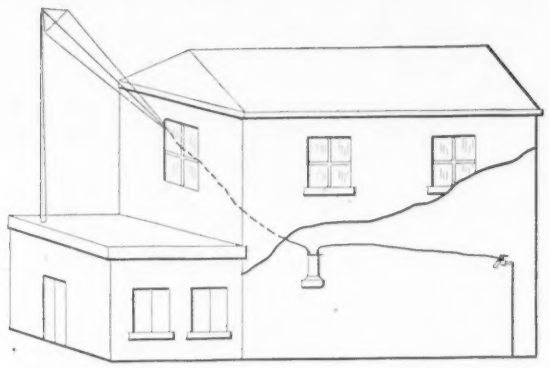


FIG. 18.—TOMMASINA LABORATORY.

and night the intensity and progress of distant storms without much inconvenience.

"On Sept. 29, 1900, exactly at midday," Professor Tommasina relates, "the weather was very fine, but the electro-radiaphone in the morning continued to indicate by various sounds and distinct shocks that discharges were certainly occuring at great distances. Toward 2 o'clock the sounds became more and more energetic. Some resembled strong and prolonged thunder claps at frequent intervals.

"Finally, the intervals between the signals became shorter, and at half-past three o'clock the sounds were incessant. The lightning at this time became visible and large clouds commenced to form; no thunder, however, was yet heard, but in the telephone the noise

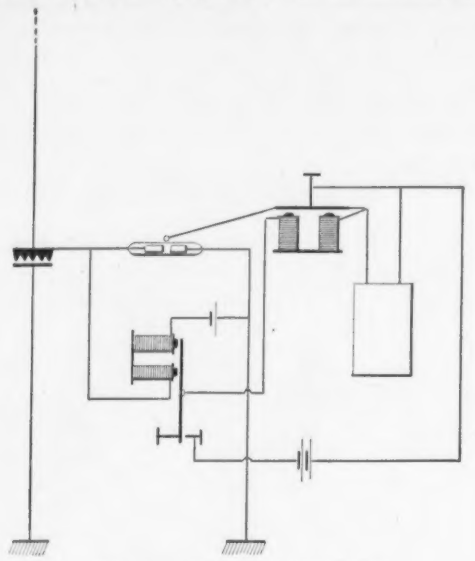


FIG. 19.—LERA ARRANGEMENT.

became progressively more intense. Suddenly it was modified and a sharp and continuous crackling was heard. Some instants later the rain commenced to fall, and at the same time the first stroke of thunder was heard. I scarcely had time to disconnect the appara-

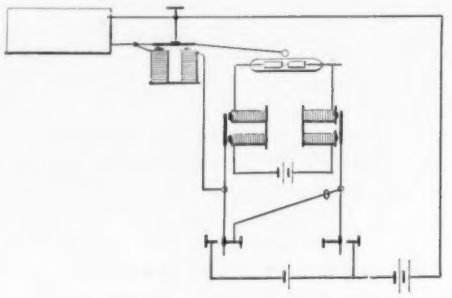


FIG. 20.—LERA ARRANGEMENT.

tus when a storm of extraordinary force burst forth. The streets were filled with water, lightning occurred without interruption, and several strokes took effect in the vicinity. Later I could hear in my apparatus the last discharges at a great distance."

M. Poggio Lera, of Catania, has successfully employed several dispositions. First he used the arrangement shown in Fig. 19. In

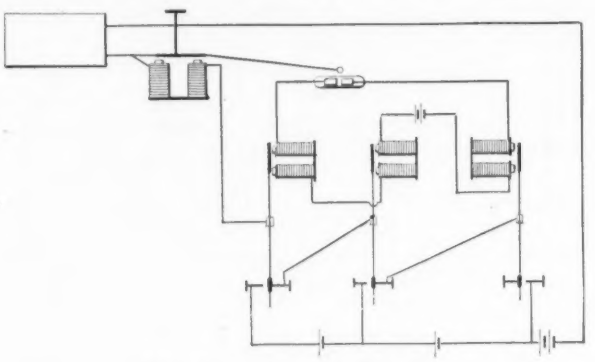


FIG. 21.—LERA ARRANGEMENT.

this arrangement there is an antenna connected to the earth through a coherer, and having in its circuit a toothed-lightning arrester and a mica condenser. The coherer is in circuit with a battery and relay, which latter closes the circuit of another battery and actuates a register and a tapper, the former being in shunt with the binding posts of the latter. Later M. Lera, relying on the fact that the lowering of the resistance of the coherer, and consequently the strength of the current in the relay, battery, coherer circuit, varies to a certain extent with the strength of the electromagnetic waves, by means of a series of relays of different sensitiveness acting progressively (Figs. 20 and 21) according to the conductivity acquired by the coherer, was enabled to devise an apparatus tracing shorter or longer lines according to the intensity of the distant discharges. Later M. Lera simplified these arrangements and employed an apparatus which differs little from that of Fig. 19. This apparatus, which is employed in several meteorological observatories in Italy, notably in Sicily, consists of an antenna connected to the earth through a toothed lightning arrester and having in circuit a coherer; a sub-

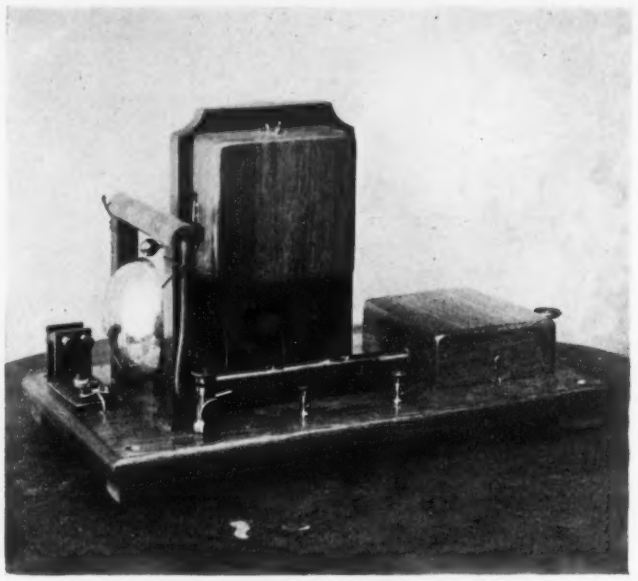


FIG. 22.—LERA RECEIVER.

stantial but sensitive relay in circuit with a coherer and a battery, actuates a bell which serves as an alarm and tapper, on the outgoing stroke the tapper striking a bell and on the ingoing stroke tapping the coherer (Fig. 22).

The coherer apparatus of Prof. Lancetta, of the Royal Technical Institution of Girgenti, and which the inventor has named the "Electrographe," consists of a grounded coherer connected with an antenna, and having in circuit a battery and a galvanometer coil, the needle of which when deflected causes a small piece of platinum to close the circuit of a battery and a bell. The armature of the bell

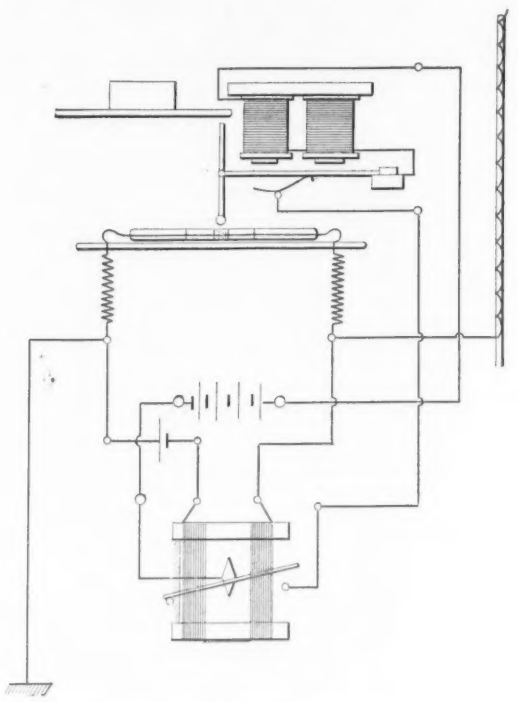


FIG. 23.—LANCETTA ARRANGEMENT.

carries on the one end a pencil and on the other a hammer. The register is completed by a dial on which the hours are marked, but in inverted order as compared with the ordinary clock dial; the dial is caused to move by clockwork, a complete revolution being

made in 24 hours (Fig. 22). When there is a stroke of lightning the coherer is influenced, the galvanometer closes the circuit of the bell, the armature of which in its motion one way makes a mark on the record and on the return movement taps the coherer. A record made by this instrument is shown in Fig. 12.

In view of the simplicity, the automatic operation and the inexpensiveness of the apparatus above described, it is to be hoped that they may enter into general use, particularly in the meteorological observatories of the world.

Improvement in Electric Transmission by Wires.

BY CHAS. E. FRITTS.

THE writer has just had issued to him letters patent on a method of suppressing the inductive resistances which are usually encountered in telegraph and telephone lines and cables, particularly those of any considerable length, and as the subject is one of considerable importance at the present time, an account of the principles involved in the system may be of some interest.

These resistances are mainly static charge and retardation in the case of telegraphic and like currents, and self-induction in the line in the case of alternating and telephonic currents. The troubles caused by them and the advantages which would result from their suppression are familiar to every engineer and practical electrician.

Although their suppression has hitherto been considered impossible, the method is simple and easy, and is equally applicable for removing them from existing lines, and for preventing them when constructing new lines; and in either case the expense is very small. The same general method is employed for suppressing both retardation and self-induction in the line. For illustration, the method of dealing with an existing line to remove the retardation will be described.

It may first be briefly stated as follows: The continuity of the line or circuit is broken up by dividing it into disconnected sections or parts. These sections are made of certain lengths, depending on the conditions in each case. The sections are then connected in series through suitable inductive devices, such as condensers or inductance coils, thus forming a virtually discontinuous line, in which the electrical impulses are transmitted over the junctions by induction and over the separate sections by conduction, the final result being the same as with the usual continuous conductors, i. e., the receiving apparatus reproduces the signals or impulses sent forth by the transmitter.

By breaking up the continuity of the line, cumulation of the retardation is prevented. As is well known the retardation increases as the square of the length of the line. A line or cable 1,000 miles in length will have a million times as much retardation as a line one mile long. The reverse is also true, and the retardation decreases as the square of the reduction in length, so that we can make the retardation in a conductor as small as we wish by reducing its length. By dividing it into sections so short that the retardation in each section is practically *nil,* and forming a line with such sections, the whole line will also be free from retardation, no matter how long it is, provided we connect the sections by devices which will transmit the signals or impulses, but on the other hand will not permit the cumulation effect in the composite line.

That can be accomplished by electrical condensers or equivalent devices, among which may be mentioned self-inductive coils. When condensers are used, the ends of the adjacent sections are properly connected to the opposite armatures of the condensers. A section thus freed from retardation is called a "non-inductive" section, and a line composed of such sections arranged in series according to the patented system, is a non-inductive line or cable, meaning one which is practically free from inductive resistances, or sufficiently so to answer the purpose in the given conditions.

The line (that is to say, the portion which is between the terminals which are operating at the time) is connected to earth through the station apparatus at each end, but it has no earth connections between those terminals, no matter how many stations it passes through or how many lines are connected in series. All intermediate calling, relaying, receiving and other instruments are inserted in the line without grounds, unless the grounded station is to become a terminal.

Owing to the absence of inductive resistances in the conductor, the possible length of line which can be operated by this system is many times greater than by the present systems. It can be relayed, however, and the new line may be organized either on this system or on the present system, as preferred. By adhering to this system, it can be relayed as often as desired, and messages can be automatically repeated to any required distance without interference by the usual inductive difficulties.

This system has been practically demonstrated. The following is believed to be a correct explanation of the theory of its operation. The first effect of the transmitter is to produce a wave or impulse of *electric induction,* or inductive influence, which travels over the whole line instantaneously (at the rate of 186,000 miles per second) and polarizes it, giving the condensers what may be called *kinetic potentials,* (i. e., having the power to draw currents in until fully charged, thus making them actual potentials) corresponding to the signals or impulses sent out—but, as yet, no current passes over the line. The actual flow of currents over the several sections to their respective condensers comes later, in consequence of the polarization of the line and the difference of potential in the condensers, before referred to; and this flow continues till the condensers are charged up to that *actual potential.* That flow of current is not instantaneous, but requires time.

The time depends on the ohmic resistance of the section (supposing that the inductive resistances have been removed) and on the electrostatic capacities of the condensers. The less the resistance, the larger the current flow; and the greater the capacities of the condensers, the longer the time required to charge them up to the proper potential. As all of the condensers were polarized at the first instant, these currents flow into all of them *simultaneously,* not consecutively, and the time required to charge all of them is the same as for one.

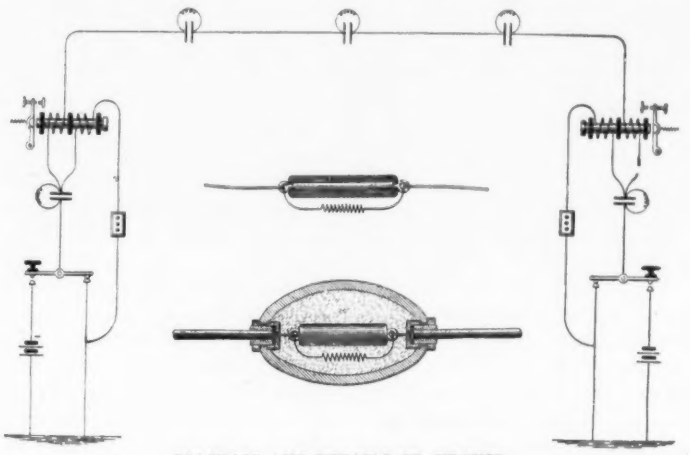


DIAGRAM AND DETAILS OF CIRCUIT.

For the same reason *no cumulation effect is possible,* and the retardation on the whole line is numerically equal to that of a single section. This last statement, about the value of the line-retardation, has not been verified by measurement, but it is believed to be correct.

It is not always necessary to remove the retardation completely, as in some cases a moderate amount of inductive resistance would be of small practical consequence. The theoretically correct amount can be ascertained by calculation, and the required approximation to perfection can be found by experiment. The amount so found will be the standard or proper inductive resistance which may be allowed in the sections of that line or circuit. The inductive resistance must not exceed that amount in any section; but it may be less than that in one or more sections, without injuring the performance of the line.

In the same way, the ohmic resistance in any one section of the line must not exceed the standard, which is normally the ohmic resistance of the section containing the transmitting apparatus, and which should properly control the action of the entire line. The frequency and rate of charge and discharge of the transmitting condenser (the one to which the generator is connected) compel a like action in all other condensers of the line. The condensers do not charge and discharge suddenly, as some might suppose, but precisely in accordance with the form of the wave or impulse given out by the transmitter. The ohmic and inductive resistances of that section are, therefore, the standard or maximum resistances allowable in the sections of that line.

The electrostatic capacities of the condensers must be sufficient to become charged to the desired potential by the current flowing through the given resistances for the time occupied by the longest signal, impulse or current wave which is to be transmitted. The electromotive

force of the generator must be high enough to send through the given resistances a current large enough to charge the condensers as described—all of which will be readily understood by those familiar with the properties of condensers.

As all the sections must conform to these limitations, it is evident that the greater the inductive resistances are in any particular line or cable, in the given conditions, the shorter the sections of that line must be cut when dividing it up, in order to conform to the principles of this system. No matter how great the retardation or the self-induction may be, it can be entirely removed by simply making the sections short enough. In case different lines are connected in series, as, for instance, a submarine cable in series with a pole line, the cable sections would have to be much shorter than those of the pole wire, although both are in the same line; and if the line is organized according to the principles of this system, it will operate satisfactorily.

It is worthy of note that this method is not limited to extended conductors only, but is equally applicable to long conductors in the form of coils or solenoids, etc. When the conductor is properly divided into sections connected by condensers or equivalent devices, the retardation and self-induction are suppressed, without interfering with the dynamic induction of each turn upon the others. The legitimate and proper action of the coil is thus greatly increased and improved, by the removal of the obstruction previously caused by the inductive resistances. This will be specially useful in the long secondaries of induction coils, by winding the coil in sections, and connecting their terminals through suitable condensers. A coil is to be treated as a part of the line or circuit which contains it, and the sections of the coil must come within the same section-standards or limits as the other sections of the line.

The foregoing is the normal arrangement of the line for alternating, telephonic, undulatory and similar currents; but with intermittent, interrupted and like currents, which terminate abruptly, such as those commonly used in telegraphy, there would be a discharge or return current flowing back over the sections at the termination of each signal or impulse, like the currents which produce the false signals or "kicks" on the ordinary telegraph lines. To prevent this in cases where such return current would be objectionable, a strongly self-inductive coil (or the equivalent of that) is arranged in shunt around the condensers.

When the current or impulse arrives at each condenser the counter-electromotive force generated by the coil prevents its passage through the shunt until the condenser is charged up to the potential of the impulse. The potential of the impulse ceasing to rise, the counter-electromotive force of the coil disappears, and the opposite charges on the two sides of the condenser then flow freely through the shunt and coil and neutralize each other therein, thus preventing any return currents flowing back over the line, which is completely freed from all static charge immediately after the passage of each signal or impulse.

As all the condensers discharge at once, the line is freed from charge at as many points as there are condensers, all acting simultaneously, making the discharge of even the longest line very rapid and perfect. The inductance coil should be such as will stop the impulse as described, and its ohmic resistance should be as low as it can be and yet have the necessary inductive power. Of course, the inductance is not to be removed in the shunt coils, but magnified.

In this modified form (after the first instant, during which the condensers are charged) the current actually flows over the line from end to end, passing through the shunts around the several junction condensers. This arrangement has the further advantage that it permits the use of a very small condenser with a large current. The arriving impulse first charges up the condenser as before described and sends on an equivalent impulse by induction through it; then the remainder of the impulse flows through the shunt resistance as long as the signal continues. With this arrangement of the sectional line and small condensers, telegraphic messages can be sent over long ocean cables with ordinary Morse instruments as slowly or as rapidly as the operator can work the key. This alone would be a valuable improvement, but it is one of the least of the advantages of this system. The accompanying illustration shows a line arranged as above described.

The shunted lines or cables can be used for all currents, but the line without shunts is for alternating, telephonic, undulatory and like currents, or for cases where "return currents" on the line are not objectionable.

As before stated, the same method is employed for removing or preventing self-induction in the line as that described for retardation. The proper lengths and resistances for the line sections can be ascertained by calculation, or, if necessary, by direct experiment. The greater the frequency and the more abrupt the rise and fall of the current waves, the shorter the sections must be. The other details of the method have already been sufficiently described.

If line wires of iron or steel are used, the ohmic resistance should be low and the sections shortened to correspond with its self- inductance, as compared with copper.

When inductance coils or other equivalents of condensers are used as the inductive connections, the foregoing explanations need no change, except the omission of the condensers.

The control of the entire line by the transmitting condenser, as before mentioned, will also result in largely freeing the line from the action of external inductive influences, such as earth currents, telephonic cross-talk, and the like.

It will be observed that this method has nothing in common with the inventions of Professor Pupin for a similar purpose. He adjusts the resistances of the line in such manner as to cause it to respond to currents or impulses of certain periodicities. This method *removes* the inductive resistances entirely and leaves the line open for the unobstructed passage of currents having any periodicities that may be desired. In a case where his method would require eight divisions of the cable per mile, this system would make the sections from forty to fifty miles in length, which shows a wide difference in the principles of the two methods. Moreover, this application for patent was filed more than ten years before Professor Pupin began his researches.

Existing lines can easily be altered to this system by calculating the proper length for the sections and inserting the condensers or other connections at or near the proper points in the line. In land lines the ordinary ready-made condensers are suitable and can generally be located and sheltered in some station or house near the proposed junctions.

For cables, the condensers (and the shunts, when used) can be enclosed in suitable water-tight junction boxes, which are then laid with the cable. There are no moving parts, nor any adjustments required, after the parts are constructed and connected as described. In altering a cable already laid, junction boxes, with condensers, etc., are prepared beforehand. The cable is underrun at the proper points and brought to the surface, the junction boxes are connected in, sealed and wrapped, and the cable lowered to its former position. Drawings and descriptions are given in the patent.

This line can be worked simplex or duplex, and with a single wire or a complete wire circuit, as preferred. With suitable modifications and additions, it can also be quadruplexed. The patent shows the duplex and simplex arrangement. For telephony, the telegraphic instruments there shown are replaced by telephonic transmitting and receiving apparatus of any desired kind, with or without the usual induction coils.

But it is especially valuable for long-distance telephony and telegraphy, and for very rapid telegraphic transmission, both automatic and synchronous. It not only admits of sending signals, impulses or waves having any desired frequency, but it actually operates better, the greater the frequency. This multiplies almost indefinitely the number of messages that can be sent over one line wire arranged on this system. The "frequency" mentioned refers to the number of the current alternations, waves or impulses—not to the etheric vibrations. It will, of course, be understood that this system is not designed for the transmission of unbroken and unvarying direct currents, but is for interrupted, alternating, undulatory, or other *varying* currents, which are subject to obstruction by inductive resistances.

When the conductor is thus freed from inductive resistances, it is reasonable to suppose that telephony will also be practicable over the longest ocean cables, and on underground and other lines through which now not a word can pass.

At first thought it appears strange to send impulses or currents over discontinuous lines or conductors, i. e., without any electrical conductor connecting the operating stations. But, as a matter of fact (with the exception just noted), practically everything that can be done on a continuous line can be done *better* on a discontinuous one, and any ordinary continuous line will operate better when altered over to this system.

Another advantage is that this system is to a great extent untrammelled by the many limiting and interfering patents which hedge about the continuous conductor systems. It is not impossible that sectional may soon supersede continuous conductors, as largely as alternating have superseded direct currents—if not more so.

Considering the many advantages of this system and the conse-

quences which must necessarily follow from the suppression of inductive resistances in electric lines and circuits, it would seem to be a very important practical improvement in electrical transmission by wires—almost a new art. It is useful for many purposes besides telegraphy and telephony, which cannot be explained at present.

Switchboards in the Astoria Power Plant, Long Island.

Some time ago the New York and Queens Electric Light and Power Company were faced with the problem of increasing their plant at Astoria, L. I., so that it could provide for the growing needs of that section, and also of supplying the necessary power for the plants at Flushing and Jamaica. The section of Greater New York which lies between Astoria, Flushing and Jamaica is one which is growing rapidly, and it was deemed advisable to abandon the direct-current arc system installed at these stations and operate all classes of business from 2,200-volt, 60-cycle, two-phase circuits. As most of the circuits are overhead and on public highways, it was not deemed advisable to transmit from the generating station at Astoria to the sub-stations at a higher pressure than 6,600 volts, although the maximum distance to be transmitted in some cases is as great as 10 miles.

The Astoria station contained two alternating-current generating units, one of 300 and one of 400-kw capacity, direct connected to vertical engines, and two horizontal Corliss engines of approximately 600-hp each, belted to a jack-shaft and to T-H arc dynamos, located on a gallery at one side of the engine room.

The apparatus just enumerated practically filled the station, and yet by the removal of the two horizontal engines, jack-shaft and arc machines, four 750-kw direct-connected, alternating-current units have been installed without undue crowding. The gallery on which the arc machines formerly stood has been strengthened, and constant current transformers for the Astoria arc lamps and the step-up transformers supplying the transmission line to Flushing and Jamaica have been installed upon it. This gallery has been extended along one side of the room for the installation of the main switchboard. The remodelled plant and the switchboard are interesting examples

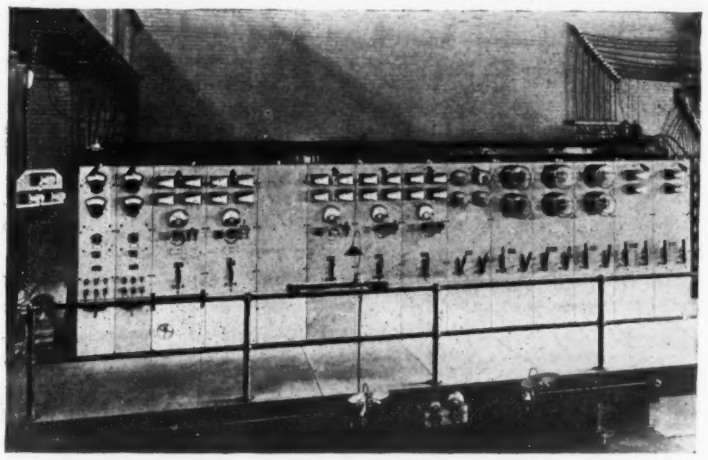


FIG. I.—ASTORIA, L. I., SWITCHBOARD.

of the economy of space with modern electrical apparatus. The switchboards show the evolution of practice from a simple marble board having all the switching apparatus and bus-bars mounted upon it, with all of the live parts exposed, to the much neater and more substantial construction of oil switches and operating levers with all live parts protected. On this board there is no more danger at the rear of the panels, and among the wires and switches, than at the front of the panels themselves; and the operator is relieved from the constant feeling that he must risk his life every time he enters the passage way behind the high-tension switchboard.

This switchboard is particularly interesting owing to the numerous kinds of service which it handles. The power is generated two-phase at 2,200 volts, and is used for incandescent lighting and power purposes at this pressure for local distribution in Astoria. The Astoria arc lights are supplied by means of constant current transformers wound for 2,200 volts primary. Power is also transmitted from the station at 6,600 volts, three-phase, to sub-stations in Jamaica and Flushing, where it is used for incandescent lighting and power on 2,200-volt, two-phase circuits, and for arc lighting with constant current transformers whose primaries are wound for 6,600 volts.

The Astoria switchboards are made up of a generating board, a local lighting and power distribution board, an arc lighting board, a low tension transformer board, and a high-tension transformer and transmission board. Duplicate bus-bars are provided throughout the entire system, and where they are not heavily insulated they are placed above the panels, well out of reach, and are protected from falling objects by strips of hard wood, one inch in thickness and grooved to fit down over the copper bars.

The main switchboard consists of one motor-driven and two engine-driven exciter panels, one 300-kw, one 500-kw and four 750-kw generator panels, one station load panel, one step-up transformer load panel, one arc load panel, one local incandescent and power

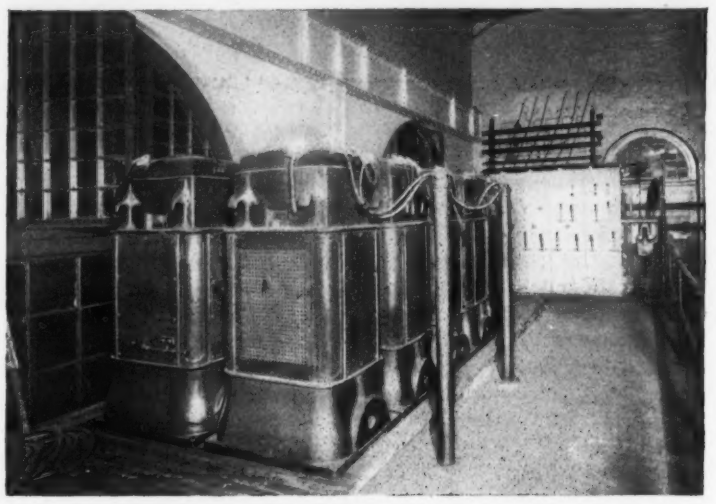


FIG. 2.—TRANSFORMER GALLERY.

load panel and two local 2,200-volt feeder panels controlling four circuits.

The arc switchboard consists of two 8-circuit panels, so arranged that the primaries of the transformers may be thrown on either set of busses, and safety devices are provided so that it is impossible for the operator to parallel the main bus-bars at this point by a wrong connection of the transformers. Only one ammeter is mounted on each panel, and it is so arranged that it may be inserted into any of the eight circuits for current adjustment.

A rather unusual but simple device is a pilot lamp in each arc circuit. This consists of a series incandescent lamp mounted on a wall bracket above the board and in plain view, so that the switchboard attendant may know at once whether the circuit is in operation. The arc transformers which are of 75 and 100-light capacity are all wound for two circuits, although they are not necessarily operated in that manner. Where two circuits are fed from one transformer, means are provided for grounding and disconnecting one of the circuits while the other is still in operation. This is necessary in order to relieve it of pressure and static charge while being repaired, and is accomplished by putting two single pole switches in each circuit, so that it may be entirely cut off from the transformer. It is then grounded by closing a suitable ground switch.

The switchboard which controls the primaries of the step-up transformers is located on the transformer gallery between the main board and the transformers. This location makes the wiring as simple as possible. The board consists of two panels, each controlling four 200-kw air-blast transformers, connected in units of two, and by which the two-phase power is transformed to three-phase at the higher pressure. The high tension side of the transformers is controlled by two panels having the operating levers for the 6,600-volt switches mounted upon them. Panels for the two transmission lines join the high-tension transformer panels, and each has mounted upon it two operating handles to control three-pole, single-throw, oil switches.

In order to warn the attendants against paralleling the bus-bars at any point excepting on the main board, a system of pilot lamps

is used. The high-tension transformer panels have colored lights directly above each switch, indicating the proper switch to be operated as soon as the low-tension switches on the transformer have been closed. Small pilot lamp transformers are connected to each transmission line in the main and sub-stations, and as soon as the line is made alive from either end it is indicated by a lamp on the line panel and fed from these pilot transformers.

The 2,200-volt switches are of the two-pole, double-throw oil type, and are mounted on the wall back of the boards. Two switches, mounted one above the other, are operated by one handle so that the combination is equivalent to a four-pole, double-throw switch. The 6,600-volt switches are mounted in brick compartments. All operating levers pass underneath the floor and up the back of the panels to the handles.

Each generator panel has mounted upon it two single-phase wattmeters, two ammeters, one hot-wire voltmeter, for synchronizing, one synchronizing lamp and plug, one 8-point voltmeter receptacle and plug, one field switch and one operating handle for the oil switches.

The entire output of the station is recorded by four single-phase integrating wattmeters, mounted on the station load panel. Two of these wattmeters are mounted in each pair of the two-phase busbars. The power to the local Astoria lighting, the arc lighting and the transmission lines are separately measured on the load panels by polyphase integrating wattmeters. The low tension transformer boards contain ammeters which show the distribution of the load on the transformers. The transformer fuses are mounted on marble slabs fastened to the rear of the panels.

The blowing apparatus for the air blast transformers is installed in duplicate and is placed on the engine room floor directly underneath the transformers. The switches and controlling devices for the blower motors are near the transformers and are operated from the switchboard gallery. The switchboards which have been described above and which are shown in the accompanying illustrations were manufactured by the General Electric Company. Mr. J. N. Bissell is the 2d vice-president and general manager of the New York and Queens Electric Light and Power Company, and the engineers who have designed and carried out the work are Messrs. J. G. White & Co., of New York City.

Comment on Existing French Conditions.

American enterprise in France is attaining considerable proportions, according to the statements made by Charles A. Conant, treasurer of the Morton Trust Company, who has returned from Paris: "Financial conditions in France," he said, "are typical of the conditions which have existed there for many years. There is an immense amount of capital seeking investment, resulting from the thriftiness and conservatism of the French people. They have lost some money in Russian industrial securities, and some in South African mines, in which they invested from $400,000,000 to $600,000,000. They will probably go back into mining investments to some extent, now that the war in South Africa is over, but those who lost are disposed to look for something different.

"France has not been swept along to any great extent on the current of economic expansion of the last few years. Few industries have been consolidated, comparatively few improvements have been made in railway equipment, and the general extension of tramways has resulted somewhat disastrously to their promoters. The fact that French manufactures are so largely those in which high artistic skill and hand labor are required has made less important the failure of the large financiers to inaugurate the economies in production and transportation which have been so important a factor of industrial development in the United States.

"Americans are interested with some French capitalists in the control of several of the Paris tramways. They are also bidding for control of the gas franchise of Paris upon much more favorable terms than were offered by the old French company. Paris has, as yet, only one subway, but the excavations are being made for several others. These subways are owned by the government, but leased to the operating companies. It is not unlikely that Americans will be bidders for the operation of some of them when they are completed.

"A few of the more educated French people are fearful that the Americans will get control of everything in France, and are fighting the gas franchise upon the ground that we ought not to be given such an entering wedge, but the more far-sighted among them are eager to get the benefit of American methods of organization, with a view to the industrial development of their country."

The Nodon Rectifier.

By P. Letheule.

The Nodon rectifier for alternating currents is based upon a well known principle, discovered in 1857 by Buff when experimenting with aluminum in an electrolyte, who observed the great apparent resistance opposed to the passing of a current from an aluminum terminal used as an anode. When used as a cathode, however, nothing different from the usual resistance was observed. Numerous attempts have been made to take advantage of this dissymmetry for the restification of alternating currents. Aluminum-carbon couples have been used for this purpose, but their practicability has not been demonstrated.

The new Nodon rectifier consists essentially of an iron cylinder, in the axis of which is fixed, by means of a rubber bushing, an aluminum rod containing 5 per cent. of zinc, the whole being submerged in a saturated neutral solution of ammonium phosphate. When an alternating e. m. f. is applied and gradually increased from 15 to 110 volts, a coating of aluminum phosphate is formed over the surface of the rod and acts as a perfect insulation up to 130 volts. This coating is formed inside of a few seconds, when an automatic device connects the terminals of the receiving system to the terminals of the alternating feeding system through the Nodon elements. Each terminal of the alternating-current system is connected to contrary poles of two elements, the free poles of the same sign being all connected together. A unidirectional current then flows from the aluminum toward the iron. The rectification of current is complete, no change of sign taking place even if the receiving circuit has no self-induction.

The efficiency of the Nodon rectifier as determined from wattmeter reading reaches 75 to 80 per cent.; it seems to be independent of frequencies ranging from 42 to 84 cycles. Both e. m. f. and intensity are reduced about 10 per cent. in the transformation. The electrolyte does not show any alterations. By regulating the current density to between 5 and 10 amperes per square decimeter by means of a glass tube partly surrounding and covering the aluminum rod, the temperature can be kept about 55 per cent. C. in a rectifier of 4 hp. The e. m. f. utilized can be as low as 50 volts.

Thermo-Electricity.

Two patents were issued July 15, 1902, to Chas. B. Thwing, one of which was on a thermo-electric element and the other on a thermo-electric generator. The positive of the thermo-electric element consists of iron or of an alloy in which iron predominates. For the negative element an alloy of nickel and copper is employed, having the proportions by weight of 1,746 parts nickel to 1,264 parts of copper, corresponding to the chemical composition $Ni_3\ Cu_2$. The element may be cast one upon the other, or joined by brazing or other hard soldering. An alloy of copper and antimony in the proportions of 9 of copper to 1 of antimony, which has a melting point slightly below that of copper, may be employed for the solder, or copper alone may be used therefor. The thermo-electric generator consists of an aggregation of the above couples. The joints of the heater are compact and brought near to one another and close to the flame, a comparatively large portion of the elements being in the path of cooling currents of air passing up through the generator between the outer side of the casing and the chimney.

Electric Locomotives for Baltimore.

The mayor of Baltimore has approved the ordinance by the city council requiring the Baltimore & Ohio Railroad to substitute electric locomotives entirely, in hauling freight trains through the tunnel under the city, in order to get rid of the smoke and cinders now given off from the tunnel openings. It is stated that the railroad will comply with the ordinance just as soon as the locomotives can be built and delivered.

Hertzian Waves and Wireless Telegraphy.

BY A. FREDERICK COLLINS.

WITH the progress of wireless telegraphy in its physical and commercial aspects there has followed, coincidently, an array of ideas advanced to account for the many phenomena which seemingly set at defiance the laws governing electromagnetic manifestations of the luminiferous ether.

These ideas are usually originated with a view to explaining away the supposed mystery surrounding two remarkable facts which have arisen since the practical application of Hertz's experiments with electric waves, namely: (1) the necessity of earthing the terminals of one arm of the oscillator system of the transmitter and of the resonator system of the receiver for long-distance wireless transmission, and (2), that the curvature of the earth is assumed to be a barrier to the transmission of the free electric waves between the radiator emitting them and receiving wire where the elevation of the latter is exceeded by that of the intervening earth.

When Hertz concluded his classical experiments, showing by purely optical methods that the long electric waves he discovered and the shorter ones of light obeyed the same laws, his work was accepted with admiration by physicists of the calibre of Lord Kelvin, Helmholtz, Poincaré and a host of others, all of whom hailed with delight the fulfillment of Maxwell's prophecy, itself based upon the experimental work of Faraday.

But when Marconi, trained in the school of Righi—who was himself a champion of the Hertzian discoveries—found that by grounding one of the terminals of the oscillator and likewise one of the resonator, and at the same time extending the opposite terminals vertically in the air, the effective distance over which the wave propagation could be transmitted was greatly increased, the experiments of Hertz were apparently so modified that at once suppositions innumerable were originated and put forth to account for the seeming changed conditions. By a few, the electric wave theory was entirely discredited; by others elaborate and cumbersome schemes, involving earthed currents and sliding waves, were put on record, but by the many the theory of free electric waves emitted by the antenna prevailed, and by these it was likewise generally accepted that the earth acted simply as a capacity and not as a medium of wave propagation. The experiment which led to this belief is described below, and the pseudo-reasoning that the earth and sea are opaque to free Hertzian waves was due to the imperfectly understood nature of the phenomenon involved.

However, it was not until wireless messages had been transmitted over such distances as to absolutely preclude the rectilinear propagation direct of free electric waves between the oscillating and receiving antennæ without the curvature of the earth offering any perceptible obstacle that the search for a theory to fulfill these conditions and requirements became popular; the following paragraphs will serve to illustrate with what diligence it was, and is at the present time, carried on.

A.—Very early in the history of the spark-gap and coherer system of wireless telegraphy the supposition was advanced that there were four varieties of alternating electric currents, *i. e.*, low-frequency, low-potential; low-frequency, high-potential; high-frequency, high-potential, and a fourth state or degree of current that is as much higher in the scale of frequency and potential as the Tesla oscillating currents are higher than the commercial alternating; it was also supposed that this "vibratory" current was the energy radiated by the wireless emitter, and that the earth or sea and air acted as conductors. This supposition accounted for the use of the antennæ and the earthed arms of the oscillator and resonator systems.

B.—Here, as in the cases above cited, Hertz's deductions and all the known laws governing the action of electric waves were set aside. This supposition shows how all the phenomena occuring in long-distance wireless telegraphy may be readily explainable if the mode of transmission be considered a form of electrostatic displacement of the charged upper strata of air. In the issue of the ELECTRICAL WORLD AND ENGINEER of July 12, this supposition is ressurrected by Prof. J. W. Gore, but it is not very ably defended by him, probably for the reason that there is little or no experimental or theoretical evidence upon which to base a "legitimate inference."

C.—The observed fact that a coherer will not act when buried in the earth is taken as sufficient proof that the earth is not a suitable medium for the propagation of electric waves; therefore, as cited above, it is to-day largely believed that the free vertical arm of the oscillator only radiates available waves. On the theory of wave interference it can be shown that this is erroneous, and that waves are emitted from the earthed terminal as well as the antenna, and that both are necessary to effect cohesion of metal filings at a distance.

D.—A supposition has been advanced by an English physicist that in the case where the curvature of the earth cuts off "the direct visual line" between the transmitting and receiving antennæ, the waves, being propagated in a straight line, were transmitted through that portion of the sea above the line joining the antennæ perpendicularly, since the sea or other body of water fulfilled the requirements of a transparent medium for the propagation of free electromagnetic waves.

E.—Another authority has advanced the very ingenious hypothesis that since water and the upper strata of air acted as reflecting surfaces the free waves emanating from the sender on reaching the upper strata of air was reflected and, striking the surface of the water, was again reflected to the air, the process continuing indefinitely, or until finally the zig-zag line of wave propagation would reach the receiving wire.

F.—Another solution has been offered by Mr. E. P. Thompson, in the ELECTRICAL WORLD AND ENGINEER of June 124, in which he contends that transmission of energy between wireless instruments within visual range is accomplished by free Hertzian waves, and that when the distance becomes so great that the curvature of the earth exceeds the height of the antennæ, the earth or water acts as a conductor for the high-frequency, high-potential oscillations, and thus establishes the connection between the sending and receiving instruments.

G.—Dr. Lee De Forest elucidates the hypothesis of sliding waves over conducting surfaces, in the ELECTRICAL WORLD AND ENGINEER of July 5, and holds to the opinion that the sea acts as a conductor for the propagations of these sliding waves. Incidentally Mr. De Forest takes Mr. Thompson to task for the latter's "confusion of ideas" and laments the "loose terminology" employed by "writers partially informed." Mr. Kintner in the ELECTRICAL WORLD AND ENGINEER of July 12, seriously objects to the theory of "rectilinear wave propagation," and, after considering the three available propositions concludes that the sliding wave idea has most in its favor.

These are only a minority of the ideas, suppositions and hypothesis offered to account for the propagation of energy which will bend around corners, follow the curvature of the earth, necessitate earthed terminals and antennæ and contribute some other properties which the adherents of the above exhibits cannot see their way clear to solve on the theory of rectilinear propagation of free electric and luminous waves.

In the article above referred to, Mr. De Forest begins by correctly defining "Hertzian waves," and stating the term to mean, "free electromagnetic waves in the ether," which is taken from Hertz's paper on "Electric Radiation[1]"; this paper describes all the electro-optical effects produced by Hertz, nearly all of which are in one way or another serving as vital features of Hertzian wave wireless telegraphy. Mr. De Forest's second definition of Hertzian waves, which is likewise correct, is summed up in the statement that they are "transverse electrical displacements or detached vibrations traveling over a conducting surface," and this is taken from Hertz's paper, "On the Propagation of Electric waves by Means of Wires[1]"; on these experiments are based the hypothesis of sliding waves, but Mr. De Forest wavers when he claims the latter has been most appropriately styled "Hertzian waves," for, on the contrary, "Hertzian waves" are universally understood by expert and laymen alike to mean "free electromagnetic waves," as set forth in Hertz's paper on "Electric Radiation," above referred to, and which have all the characteristics common to and following the laws of light waves.

"Oscillating currents" would be a much more appropriate name for electric waves traversing wire and "Hertzian" or "electric waves"

[1] Electric Waves, by Hertz. Translated by D. E. Jones.

should designate the energy radiated from oscillating currents in the form of undulatory disturbances in free ether. It would seem to the "partially informed" that Mr. De Forest is a little mixed in his terminology when he states that "pulsations at the rate of a million per second" cannot be classed with "alternating or oscillatory currents."

While oscillating currents are alternating, alternating currents, on the other hand, are not termed oscillating. By alternating currents the writer has labored under the impression that the term designated the process of producing a low-frequency current by moving bobbins of wire to and from magnets[1]. and that oscillating currents were currents of high-frequency and high potential produced by the sudden discharge through a small resistance of two charged surfaces having a large difference of potential, as a Leyden jar or the oscillator system of an induction coil; when the periodicity of the surging charge exceeded the oscillatory to the extent of producing visible waves, the term "vibratory" is employed. An oscillating current having a periodicity of 1,000,000 or 100,000,000 is certainly oscillatory.

Again, the conclusions of Mr. Thompson are not so widely divergent—though not so elegantly expressed—from those of Mr. De Forest that the latter should consider for a moment the inconsequential misinterpretation or misuse of the terms accepted by the "wholly informed." Although Mr. Thompson's ideas of long-distance wireless telegraphy and my own differ very materially, his were clearly enough expressed, and his drawing showed at a glance exactly what his article intended to convey, namely, that where elevations intercept the visual range from one antenna to another the energy is transmitted by "electric oscillations," or as Mr. De Forest would rather have it expressed, by "Hertzian waves."

By assuming salt water to be a perfect conductor of electricity—which it is not—and, therefore, "completely opaque" to electromagnetic waves, Mr. De Forest is able to account for the necessity of grounding the one terminal of the oscillator and resonator as well as eliminating the supposed interference of the curvature of the earth. But salt water conducts only by electrolytic action, and instead of being opaque to electromagnetic waves it is a fairly good medium for their propagation. However, the hypothesis advanced by the foremost technicians in wireless telegraphy does not call for the transmission of free Hertzian waves through the water or waves which slide over its surface, but Hertzian waves produced by electric oscillations and emitted in the form of etheric radiations just as the vibrating charge of an atom sends out waves which travel in straight lines in the transcendental matter called ether, through and by which they are propagated, but when the ether becomes identified with gross matter the waves may be made to diverge from the normal line of propagation even to the extent of describing a complete circle, as in the familiar optical experiments wherein a number of prisms are arranged in a position, likewise describing a circle.

The idea that the earth and sea are opaque to Hertzian wave radiation apparently found its origin in an experiment first made by M. Guarini, who ascertained that a coherer when buried in the earth with the proper receiving appliances was unaffected after the emission of the waves above the surface. This also, possibly, gave rise to, or accentuated the belief in the hypothesis of sliding waves, which if my memory serves me aright Prof. Fessenden first advanced.

In order to test the validity of the statement that earth and water are opaque to Hertzian radiation I placed a symmetrical oscillator system, *i. e.*, without earthing one arm, and a similar receiving system in basements on opposite sides of the Schuylkill River (Philadelphia); the transmitting and receiving instruments set below the surface of the river and the oscillator and resonator systems were placed in horizontal positions and parallel with each other. The instruments were encased in zinc boxes with openings on one side only, so that the emitted radiation would be propagated through the basement walls and the river. There was no difficulty in obtaining calculations across the river, although the distance was short and a four-inch spark coil was employed. That the waves passed through the intervening earth and water is as certain as their passage through free air.

In combating the pseudo-hypothesis of sliding waves it will not be necessary to evolve here the theory of electric wave interference wherein one set of waves is propagated through the earth or water and its component set of waves through the air, but it will suffice the purpose of this paper to hold only to the theory of rectilinear wave propagation through the air, which is only a part of the electromagnetic process involving the true Hertzian waves or radiation, as employed in wireless telegraphy.

The part that seems to puzzle the novice who attempts to apply the Hertzian radiation theory to the practice of wireless telegraphy lies chiefly in the use of the earth plates at the transmitting and receiving ends.

Over short distances, just as Mr. Thompson said, the coherer effect is due to free Hertzian waves, but contrary to his idea, it is not the lack of a direct visual line between the co-operating instruments which prevents long-distance transmission of the waves, but in the great difference in electrical resonance or "tuning" of the electric wave circuits of the oscillator and resonator which forms the vital part of the apparatus.

When the emitted waves are powerful and the instruments are quite close together, this divergence of resonance is not such an important factor in causing and effecting results, but as the distance is increased the necessity for exact tuning becomes more and more a matter of vital importance, and, practically, absolute resonance of the oscillator and resonator circuits can be obtained by one method only, and that is by the expedient of grounding one arm of the systems.

The reason for this is simplicity itself; capacity and inductance are the leading co-efficients in the tuning of electric circuits, as Lodge has shown in his experiments with the syntonic jars; by virtue of the unknown value of the resistance of the spark-gap of the oscillator during the disruptive discharge and the difficulty of obtaining exactly the same degree of resistivity of the coherer after tapping, it is exceedingly hard to obtain resonance in commercial systems without resorting to the method of loading a large and like capacity on the oscillator and resonator, but when such a capacity—as the earth offers—is attached by means of an earth plate to one arm of the oscillator and one arm of the resonator is likewise earthed, whatever their distance may be apart they will fulfill the law of resonance, and the systems will be in tune or syntonized. Under these conditions it is clear that any receiver within the sphere of action which may have one arm of its resonator grounded will respond to the transmitter, assuming that it is in adjustment and that its opposite arm extends into the air the proper distance, and any amount of inductance or capacity, or both, which may be added above ground in the form of coils and Leyden jars will avail the designer of such a wireless telegraph system but little since these additions are as a molecule in a litre of water.

This is the greatest technical difficulty Mr. Marconi, Dr. Slaby and all others who are working with earthed terminals have had and will have to contend with in their efforts to produce individual syntonized systems. Sir Oliver Lodge operated effectively a multiple tuned or syntonized set of instruments over comparatively short distances by doing away with the earthed connections. Prof. Braun has, in my opinion, approached the goal of individual syntonic wireless telegraphy more closely than any other inventor; this he has done by eliminating the untoward results of exaggerated capacity which the earth produces and by combining the good qualities of the closed circuit oscillator with those of the open circuit oscillator, as described in my recent article in the ELECTRICAL WORLD AND ENGINEER of June 14.

Loading one end of the oscillator and that of the resonator with so gigantic a capacity as the earth, leaves little opportunity to vary the emitted wave length, and any calculation for oscillator and resonator systems is at once grossly in error the moment the terminals are earthed.

That the curvature of the earth should be assumed to be a complete barrier to the rectilinear propagation of free Hertzian waves by the adherents of other dogmas is surprising, for the simplest law of optics explains easily and naturally how electric waves traveling in straight lines may be made to act around a corner or the arc of a circle equal to the quadrant of the earth's circumference; nor is it needful to work this law overtime as in the hypothesis giving a continuous zig-zag reflection from the upper strata of air to the surface of the sea, and *vice versa*, to account for the phenomena of rectilinear propagation of electric waves.

The reflection of the sun's rays before rising and after setting offers an exactly similar proposition in producing twilight and dawn. By reflection and diffusion of free Hertzian waves all the phenomena of long-distance wireless telegraphy by rectilinear propagation is at once made clear. A searchlight directed against the sky at night gives a visual reproduction of identically the same

effect which takes place when the oscillator system is substituted for the vibrating system of the arc-lamp and the coherer for the human eye.

In conclusion, it is safe to say that the rectilinear propagation of free electric waves will be accepted as the true solution for the responsive action of a wireless receiver to that of a distant transmitter for whatever time the theory of light based on undulations of the luminiferous ether prevails, or as long as the electromagnetic theory of light endures, and to the finality of belief in the theory that Hertz's free electric waves are of the same origin as light waves.

Wireless telegraphy is getting out of its swaddling clothes rapidly, and as it grows new phenomena will be constantly observed, but in the future whatever may arise of a seemingly anomalous nature, it would be well to test the applicability of known optical laws before resorting to explanations founded on mere fancy or to build hypothesis on phenomena of which the principles are far less known and more deeply merged in the darkness of obscurity than the electro-optical laws which Hertz has shown to govern free electric as well as light waves.

New Telephone Patents.

The issue of the Patent Office for July 22 has two patents relating to telephony, one granted to Mr. Mason Grover, of Bidwell, Ohio, covering a device for preventing humming of telephone wires, commonly called a damper; the other to Mr. William Kaisling, of Chicago, assignor to the Kellogg Switchboard and Supply Company, covering a supervisory relay.

Mr. Grover's improved damper, as shown in the drawings, consists of a tapered body, of the form of the corks used by runners when competing for records, which is split to admit of placing the wire in the central groove or bore. A peripheral groove allows of binding the damper on the wire, the tie-wire being attached to the

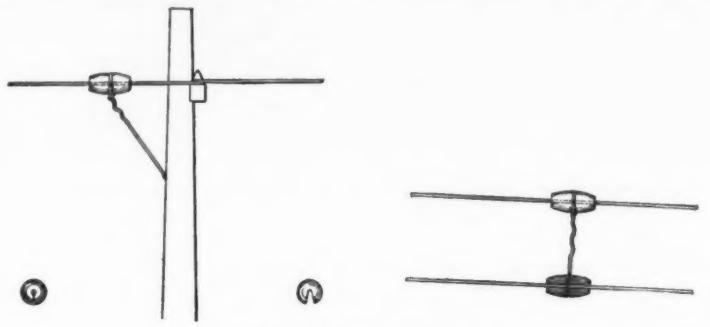


FIG. I.—GROVER DAMPER.

damper on a neighboring wire, or to the pole or fixture. Mr. Bidwell preferably uses rubber for his damper, but points out that any suitable "dampering" material may be used and any proportions may be observed without departing from the spirit of the invention.

Mr. Kaisling's relay invention has for its object to provide a compact and efficient relay, and more particularly to provide means for mounting the armature of the relay. The accompanying fiugres give a longitudinal sectional view; a view partly in section; an end view with the cap *f* in section, and the armature *c* removed and the supporting strip, c^3 partly removed; a detail view of the back contact d^2 and its mounting; a detail view of the armature and its mounting, and a view showing the manner of securing the armature to the suspending spring. The relay is surrounded by a shell, *a*, in which the core a^1 is mounted, a^1 having a threaded shank a^2 passing through the shell and secured by nut a^3. The winding *b* is held between insulating end pieces C^1 C^2, and the ends of *b* are connected to the conductors b^3 b^4.

The armature, *c*, is circular; at its center is a tapped hole to receive a screw, c^1, secured by nut c^2, the end of c^1 carrying a platinum contact-point, c^5, which is one of the contacts of the relay. Armature *c* is suspended opposite the end of a^1 by means of spring-strip, c^3, which is preferably of copper. The upper end of c^3 is screwed to shell *a* by screw c^4, and the lower end is secured to the armature *c* by being bent at right angles and inserted in a slot near the periphery of *c*; the circumference of *c*, after the bent end of c^3 has been inserted in the slot, is prick-punched to make the joint secure. The strip c^3 acts as a spring to maintain the armature normally a short distance from the end of the core. When the armature is attracted the metallic circuit is completed from the shell-terminal e^3, through shell and spring c^3 to the armature contact c^5, thence to back contact d^2 and by wire e^2 to terminal *e*.

The advantage claimed for the means of suspending the armature is that the weight of the armature is balanced and, therefore, the only strain to be exerted by the magnet is against the spring copper-strip c^3. The mounting of the back contact is as follows, and is

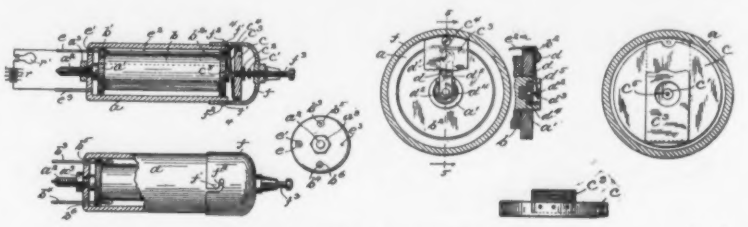


FIG. 2.—KAISLING SUPERVISORY RELAY.

clearly illustrated in the small sectional figure. Upon the front insulating-plate C^2 a spring-strip, *d*, is secured by screw d^1. The lower end of *d* carries a platinum contact, d^2, adapted to make contact with c^5 on *c* when *c* is attracted. The contact d^2 carries a shank, d^3 extending back into an opening in the insulating-block, d^4, inserted in a bore in the end of the core a^1. The face of the insulating-block, d^4, rests at a distance from the end of the core, so that the contact d^2 rests wholly within the end of the core. A slot, d^5, is provided in the core to allow the passage of the strip *d*. The strip c^3, supporting the armature, has a central opening to permit the contact c^5 to engage the contact d^2. The circuit controlled by the relay is clearly indicated, one wire, e^3, being connected to the shell and the other, *e*, being connected by wire e^2 to the back contact-strip *d*. As shown, the cap *f* carries an adjusting screw, f^3, by which the distance of the armature from the magnet may be regulated. Mr. Kaisling has produced a compact and neatly-designed relay.

Meeting of New York State Independent Telephonists.

At Rochester, N. Y., on July 25, about 100 representatives of independent telephone companies operating in the State of New York convened for the purpose of forming a State association. Owing to rivalry springing up over the question of two long-distance connections, a split occurred in the convention, and after many animated scenes the adherents of one of the long-distance interests bolted after the friends of the other had secured the temporary organization. Eighty-five per cent. of the delegates then went into convention at the Powers Hotel. Among others, the following companies were represented. Rochester Telephone Company, Home Telephone Company of Albany, Niagara Falls, Tonawanda, Lockport, Medina, Batavia, Warsaw, Troy, Schenectady, Elmira, Binghamton, Newburg, Catskill, and Rome, N. Y.; Kingston Standard Telephone Company.

The following officers were elected: President, G. R. Fuller, Rochester; first vice-president, Homer Hendrickson, Albany; second vice-president, Boyd McDowell, Elmira; secretary and treasurer, C. O. Harris, Rochester; advisory board, S. B. Lawson, Niagara Falls; J. S. G. Edwards, Johnstown, N. Y.; J. S. Bradley, Jr., Utica; Edward Davis, Troy; F. N. Potter, Jr., Syracuse; C. D. Vernoy, Cortland, N. Y.; W. D. Bernard, Saratoga; E. L. Barber, Rome. A constitution and by-laws were then adopted, and the organization made permanent, after which the convention adjourned sine die.

The bolters' convention also elected officers as follows, after which they adjourned to meet in Buffalo to perfect organization: President, Martin Carey, of the Frontier Telephone Company, Buffalo; secretary, Charles H. Blood, of the Ithaca Telephone Company of Utica.

The differences are of minor importance, and negotiations are already under way looking toward a union of the two organizations into one and an adjustment of all differences arising in the convention.

International Tramways Union Congress in London.

The twelfth annual congress of the Union Internationale Permanente de Tramways was held last month in London, at the Agricultural Hall, under the presidency of M. Leon Janssen, the able managing director of the Brussels Tramways Company, and extended over four days, ending July 4. The proceedings were conducted in French, occasionally in English or German, and an interpreter made a memory brief of each speech in English for the benefit of those not understanding the other languages. A great deal of excellent work was done, of which note is made below; and there was, in addition, an exhibition of street railways apparatus.

The opening address was made by M. Janssen, who indicated the useful work attempted and done by the body, and noted the fact that not only had various governments sent representatives, but that some of their members had been honored by special recognition. The chair was then taken by Sir C. R. Wilson, who welcomed the congress to England, regretting that they would find that country far behind others in traction work. The union accepted an invitation from the mayor of Islington to lunch, and attended a conversazione of the Institution of Electrical Engineers at the Natural History Museum. Several plants were also visited, and the congress closed on Friday, with a banquet at the Royal Hotel.

An interesting paper was read by Dr. M. G. Rasch, instructor of the Polytechnic School at Aix-la-Chapelle, on "A Proposed Basis for Estimating Powers of Motors." He referred to the regulations which had been issued by the German Association of Electrical Engineers regarding the testing of generators and motors, and commended them to the consideration of the congress. He urged the carrying out of tests extending over a longer period than one hour—the time stipulated by many companies—and the fixing of the normal full load of the motor at such a figure that it will bear, say, a 25 per cent. overload for 30 minutes without injury. The question of temperature rise was next considered, it being pointed out that the limit of permissible temperature rise depended largely upon the character of the insulation employed. Thus, under the German regulations, the figures were, for cotton insulations, 50° C.; for paper, 60°C., and for mica or similar materials 80° C. above a surrounding atmosphere having a temperature not exceeding 35° C. (say 95° F.). For stationary coils a further margin of 10° C. is usually allowable, and, for tests carried out in a test room, the above limits, it was stated, may be increased by 20° C.

Dr. Rasch agreed with those who insisted that high efficiency was not the primary consideration in the design of a traction motor, and pointed out the considerations as to weight and temperature rise, which were also of great importance. He concluded by suggesting that, taking the method of rating a motor proposed by the German Association of Electrical Engineers, the following particulars should be asked for in tenders for half, full, and 50 per cent. overload: (*a*) Current in amperes; (*b*) torque in kilogrammetres; (*c*) speed per minute; (*d*) efficiency. Mr. Macloskie, whose work had been referred to, agreed with the suggestion that the basis for rating motors proposed by the German Association was a good one. M. Pedriali, of Brussels, was in favor of officially adopting the proposals of the German Association of Electrical Engineers as standard, but Dr. Rasch observed that as they stand they are not suitable for traction work, and it would be for the congress, if it adopted them, to suggest several modifications. Herr Max von Leber, of Vienna, thought that local conditions were so different that it would be very difficult to arrange any set of tests which would be suitable for all conditions. Messrs. Scotter, F. W. Egger and others spoke on the subject, but nothing definite was done, the question going over until 1903.

Mr. Chas. Thonet, engineer and manager of the General Contract Company, of Liege, Belgium, read a paper on central stations. It was divided into two portions; the first dealt with the present tendencies of power station design on the Continent, the second with the cost at which electrical energy was produced in a number of important tramway stations. He gave various details, for instance, boilers with fire-boxes suitable for burning petroleum are coming into extensive use in Russia and Roumania; on the Continent stokers work on an average eleven hours per day, and the use of superheaters is becoming general, though few companies will give any details as to the actual economy they effect. Cooling towers are extensively employed, and considerable attention is paid in many quarters to the purification of the feed water before admission to the boilers, but mechanical stokers appear to meet with little favor. In large generating units the engines are generally cross-compound, with the generator between the cylinders; in Berlin and Paris triple-expansion sets are in use, and some useful steam consumption tests figures are given. Mr. Thonet referred also to the working of several producer gas stations with which he is connected, and concludes this part of the paper with a number of details regarding dynamos and accumulators. The second portion gives the results of working of a number of stations using steam and producer gas, and stated that the coal consumption per hp-hour for even the smallest station equipped with gas engines is far from being as high as that in steam plants. He gave power cost data from a number of roads.

Mr. R. H. Scotter, of Warrington, read an interesting and comprehensive paper upon "Legislation in all Countries Relative to Tramways and Light Railways." He urged the collection and collation of résumés of the different laws in actual operation, and described English practice and procedure both under the Tramsways Act of 1870 and the Light Railways Act of 1896. The evils resulting from the limited tenure, the right of veto of local authorities, and also of frontagers, were brought out and compared with the practice in other countries, notably Belgium, where, owing to more enlightened regulations, a system of light railways or chemins de fer vicinaux has proved a great commercial and social success. In this plan the interests of the government, the local authorities and the public are as far as possible harmonized, with the result that schemes are matured along lines which ensure not merely local, but national, prosperity. He commended the British practice of holding local inquiries as worthy of imitation. The rest of the paper dealt with the length of time taken in various countries to obtain concessions, the duration of concessions, gauge, width of roadways, the question of ultimate ownership, and the suggestion of various points for the consideration of future congresses.

M. M. A. Trautweiler, chief engineer of the Strasburg Tramway Company, read a paper on "Car Barns and Their Location," summarizing some seventeen replies to inquiries. The answers were of such a varying character that it was impossible to base any very specific recommendations upon them. Some companies favor a number of car sheds so distributed over the various routes that the number of non-profitable car-miles run was a minimum. Some went as far as to suggest a small shed at or near each terminus, so that the traffic on that particular line would be adjusted to meet varying requirements. Speaking generally, seven of the seventeen companies, and among these are those owning the greater number of cars, advocate concentration; the remaining ten favor distribution among several sheds. He held that in many cases the additional maintenance expenses incurred by dividing the cars between a number of sheds have not been sufficiently appreciated, and that too much importance has been laid upon the cost of running idle cars to and from the main depot. M. Trautweiler thought that so long as not more than 100 to 150 cars are required for any system, one shed is best, but that for large undertakings several car sheds, each having accommodation for the above number of cars, will prove most economical. This conclusion is in general accordance with American practice, where a small number of large car sheds is the rule. For ease of comparison, he instanced a system having about 27 kilometers of track, 70 motor cars, and as many trailers; where the car house, if a single one were used, would have to be one and one-half kilometers from the center of the city. Such a road would find one car barn more desirable than several.

M. Ziffer, of Vienna, president of the board of directors of the local railways of Bukovina, read a paper on "Systems of Traction," dealing, in an exhaustive manner, with the various types of conduit and surface contact systems of electric tramways proposed or adopted. For each 100 kilometers of track electrically equipped, of which returns have been received, 82 employ the overhead trolley, 7 a conduit system of one type or another, and 11 are worked with cars carrying accumulators. Dealing first with conduit systems of working, M. Ziffer gave

a history of early efforts, and described in detail the conduit lines at Brussels, Paris, Buda-Pesth, and Vienna, with the costs of construction and operation. The second portion of the paper presented information regarding surface contact systems of traction. The Schuckert system, on a short line at Münich, the Claret-Vuilleumier at Lyons, the system of the Thomson-Houston Company, of Paris, installed at Monaco and Monte Carlo, the Diatto system at Tours and Paris, and the Lorain system recently placed in use at Wolverhampton were all referred to. He concluded by pointing out the real need for a reliable surface contact system, and considered that at present all systems in use are of a more or less experimental character.

M. Poetz, of Hamburg, Germany, read a paper on "Tramway Brakes." It discussed hand, air, electric and friction brakes, and described tests on the power of different brakes, their power being expressed in terms of the distance in which a given car could be brought to rest from a given speed. He expressed himself in favor of electric rather than air brakes in all cases where the number of trailers does not exceed one or two. In the discussion M. Thonet spoke in support of the author's tests and results. He gave the following results of tests made under his direction, at a speed of 20 kilometers per mile. The figures give the distance in metres run before stopping.

For one car.....14.0 for air brake.
For one car.....12.5 for General Electric brake.
For one car.....11.6 for Thomson-Houston brake.
For one car and one trailer.18.1 for air brake.
For one car and one trailer.15.6 for General Electric brake.
For one car and one trailer.11.7 for Thomson-Houston brake.
For one car and two trailers.20.7 for air brake.
For one car and two trailers.19.4 for General Electric brake.
For one car and two trailers.14.7 for Thomson-Houston brake.

Herr Koehler disapproved of the magnetic brake, which he had tried in Berlin. He regarded the air brake as more reliable. Herr von Leiber, speaking on behalf of the Austrian government supported the author's claims as regards electric brakes. In Vienna they had decided to adopt electric brakes.

M. S. Peiser, of Berlin, read a paper on "Heating of Cars," as practiced in Germany, including a stove for burning briquettes. He spoke of electric heating as expensive, but believed the subject of sufficient importance to warrant further inquiry into it by the union.

Mr. P. V. McMahon, chief engineer of the City and South London Railway, read a most interesting paper on "Underground Tube Railways." He made a comparison between the existing electric tube railways in London, and discussed the relative advantages of deep and shallow level tunnels, arguing in favor of the latter. At the opening of the City and South London Railway it was looked upon by Continental and American engineers as a fine piece of engineering. But it went on quietly carrying seven million passengers a year without any notice from the general public and the press until the Central London Railway was opened, and then it was rediscovered. It paid a dividend from the start. Separate locomotives have many advantages over the system in which the motors are fixed to each car. They tried a motor car train several years ago on the City and South London line. It gave greater seating capacity for the same weight, and the coal consumed per passenger carried was slightly less, but unnecessary time was lost at terminal stations, due to the driver and assistant having to change positions from one end of the train to the other. More spare carriages are required, and sidings have to be larger. If one compares the continuous-current system on the City and South London with the Central London three-phase system it is seen that less has to be spent in copper. In the Waterloo and City Railway the generating station is at Waterloo, operated on the two-wire direct system at 500 volts. There are no elevators, and motor car trains are used. For heavy traffic four-coach trains are run. The front and rear carriages have two motors on the leading and trailing bogies; they carry 46 passengers each, while the two intermediate carry each 56 passengers, making a total seating capacity of 204 passengers. The normal rating of motors is 42 b-hp—that is, 70 to 100 amperes at 500 volts. These are run for three and a half to four hours in the morning. The total weight of train is about 100 tons, and the time taken between stations is five minutes, the average speed being 18 miles per hour. For light loads single motor cars are run, weighing 26 tons, and make the journey in four minutes, speed 22.5 miles on the average. They ascend the 1 in 60 gradient at 30 miles an hour. The coal consumption is 5 pounds per kw-hour. The number of passengers in the half year is two and one-half millions. On the Central London Railway current is generated at 5,000 volts, and reduced to 550 at the line. Each train consists of seven carriages on eight-wheeled bogies, weight unloaded 98 tons, and the seating capacity 336. Locomotives are used, but motor cars are being made. Each locomotive is 117-hp. The maximum current at full-load is 1,200 amperes for each locomotive, and its weight is 44 tons. The passengers carried for half year are 20,802,650. Mr. McMahon's road is operated on the 5-wire system, continuous current, whose efficiency he compared favorably with that of the alternating current method. The locomotives have two gearless motors, weighing 13.65 tons; or a fully loaded train 49.8. He presented several curves, and some data as to high acceleration.

Storage battery traction came up in one of the discussions and fared rather badly. Herr Köhl described the battery system in Hanover as absolutely ruinous, and said that both in Hanover and at Hagen accumulators had been given up. M. Thonet, of Liege, said that, although the horse tramways at Dunkirk had been worked for nineteen years and paid a good dividend, when accumulator traction was adopted the concern soon became a losing one. The batteries only lasted five months, there were numerous stoppages, and, as a result, traffic was disorganized. Several other speakers condemned the battery system, including Messrs. Koehler, Bonevin, Lavalard and Von Leber, and a resolution was passed condemning the use of storage batteries in street railway work.

Tributes to the Memory of Mr. Mackay.

Special meetings of the officers and directors of the Postal Telegraph Cable Company and the Commercial Cable Company, for the purpose of taking suitable action upon the death of John W. Mackay, president and director of both companies, were held in New York City on July 25. The Commercial Cable meeting was presided over by Mr. A. B. Chandler. The Postal Telegraph Cable meeting was presided over by William H. Baker, vice-president and general manager of the Postal Telegraph Company. Resolutions were passed relative to the death of Mr. Mackay, and brief speeches were made by several present, many of whom had been intimately associated with Mr. Mackay both in business and socially.

A part of the resolutions passed by the Commercial Cable Company was as follows: "In making this record this board desires to record also its high appreciation of the surpassing merit of Mr. Mackay as a man, a citizen, and a friend, as well as in his capacity of chief officer of this company. We recognize that the existence of this company is due to his foresight, his courage, his ability, and his generosity. We believe that no other man would or could have created a telegraph system of such wide extent and such merit under the great oceans and throughout our vast continent in the midst of such difficulties and discouragements as have surrounded those enterprises almost from their inception. We feel the loss of his command, his counsel, and his friendly and encouraging presence as a personal affliction to each one of us, and we know that this feeling exists among all officers and employees throughout the service."

The directors of the Commercial Cable Company are: Edward William Hawley, James Gordon Bennett, Gardner G. Howland, Col. William Jay, George G. Ward, Sir W. C. Van Horne, Edward C. Platt, W. Seward Webb, Lord Strathcona, Charles R. Hosmer, Thomas Skinner, Clarence H. Mackay, Albert B. Chandler, Dumont Clarke.

In the course of the resolutions of similar effect adopted by the Postal Telegraph Company, the following graphic passage occurs, in regard to its late president:

"He was honest, his name being a synonym for honesty. He was just, wronging no man. He was generous, ever aiding the needy. He was far-seeing, judging correctly men and affairs.

He was humble, seeking no place above his fellows. He was ambitious, striving not to gain honors, but to do good. He was courageous, knowing no fear. He was patient, waiting with confidence for the fruition of his labors. He was strong, bearing adversity with fortitude and prosperity without pride. He was righteous, fearing God and loving his fellow-men. Fortunate in unlocking, by persistent endeavor, the treasure house of Nature, he used his vast wealth wisely. Great in simplicity, earnestness of purpose and fidelity to principles of right, he compelled the admiration and won the love of those who knew him."

The officers and directors of the Postal Telegraph Cable Company are: William H. Baker, Edgar C. Bradley, George G. Ward, C. H. Mackay, A. B. Chandler, Edward C. Platt, George Clapperton, Sir W. C. Van Horn, Charles R. Hosmer, James W. Ellsworth.

A cable dispatch from London announces that the Pope has granted Mrs. John W. Mackay special permission to hold private services over the body of her husband. A memorial service for Mr. Mackay will be held in the Church of St. Peter and St. Edward, Buckingham Gate, during the present week. Quantities of floral tributes are daily received at the Mackay home. Among these was a five-foot column of asters, with a broken cable of steel-colored flowers, with the words "Atlantic and Pacific" at the base. The Postal Telegraph Company sent a handsome cross. Among the many who have called at the Mackay house, or who have sent messages of condolence are Charlemagne Tower, United States Ambassador to Russia, and Mrs. Tower, Lord Strathcona, and Mount Royal, Canadian High Commissioner in London, and Lady Strathcona, James Gordon Bennett, Baroness de Reuter, Nikola Tesla, George Gould, Dr. Seward Webb, of New York; Princess Louise, United States Ambassador Choate.

In an anecdotal contribution to the New York *Times*, Mr. H. Allaway, who has met all of the financial celebrities of his time, says: "In Mr. Mackay's career nothing was ever attempted with enthusiasm beyond that which he had in his ambition to establish the Pacific cable. Over seventy years old, he still could foresee and plan and hustle. Why not put his capital into some less extraordinary enterprise? Why the part of the Pacific cable pioneer? Easily answered, such conumdrums, he said: 'I don't want to bother with railroads, and be bothered by them. But I am obliged to invest the capital. So I've decided to put the money into something where they can't be holding me up forever on rights of way and town taxes—put the money where they'll have to swim to get it.' There be land-lubber financiers who can appreciate this Mackay philosophy."

Mr. Chandos Fulton, in the same journal, says: "When asked to select his office in the Postal Telegraph Building, Mr. Mackay, as soon as he had entered the room on the southern corner, decided on that, giving directions that his desk should be placed as he indicated, affording a view over the City Hall Square down into Frankfort street. 'From this window,' he said, 'I can see the site of the house in which I lived as a child before I dreamed of going to the Coast, or ever amounting to anything.'"

Reported Change From Steam to Electricity of Ohio Railroad.

A report that the Appleyard syndicate has secured the lease of the Cincinnati, Lebanon & Northern Railway, a steam road operated by the Pennsylvania Company, has been both confirmed and denied in financial and traction circles. The Appleyard syndicate has been seeking an entrance to Cincinnati from Lebanon to complete the line now practically complete from Columbus to Lebanon. The steam road is in fine condition, and the electrical equipment could be installed so that the through line could be in operation this year. The acquisition would afford fine terminal facilities in Cincinnati, and make the syndicate independent of the Cincinnati Traction Company. In steam road circles the reported lease is discredited, as it is claimed the Pennsylvania some time ago placed a price of $8,000,000 on the property, which is figured to be almost prohibitive for traction purposes. The Appleyard syndicate has opened offices in Cincinnati, and it is stated that Cincinnati and Boston banks are about to arrange for a consolidation of all the Appleyard interests between Columbus, Dayton and Cincinnati.

Recent Progress in Electrochemistry.

By Clinton Paul Townsend.

BAKING CARBON ELECTRODES.

Mr. Charles M. Hall, of Niagara Falls, describes the following disposition of apparatus for baking carbon electrodes, particularly such as are intended for the electrolytic decomposition of fused baths, as in the production of aluminum. The carbons are arranged horizontally or vertically, and in one or several rows, around the carbon core and within the masonry walls of a furnace, the carbons being insulated not only from the core, but from one another by means of a refractory and non-conducting powder such as bauxite, purified alumina, magnesia, etc. Upon the passage of a suitable current through the core, the carbons are brought to a temperature of 3,000 or 4,000 degrees Fahrenheit, the interposed insulation guaranteeing against the diversion of notable quantities of current through the carbons themselves. Data are given as follows: A core four or five feet in length and twelve by thirty inches in cross sectional area requires to have developed therein 400 to 500-hp by an alternating current of 35 to 50 volts.

The conducting core is preferably of granular charcoal or coke, but the inventor suggests also the employment, as a heating resistance, of a fused electrolyte, in which case the baking of the carbons becomes an additional feature of the exceedingly interesting method of purifying bauxite by the reduction of its impurities heretofore fully described. De Laval has employed the heat developed in a fused electrolyte for producing a useful effect, as in the superheating of metals or even the smelting of ores, but the method here described is unique in its utilization of both the electrolytic and thermic effects of the current.

The disposition of parts calls to mind the recently described method of Acheson for graphitizing carbons by arranging them in piles, separated by powdered carbon, between the circuit terminals. As a matter of fact, however, the relation of the fusing point of any available insulator to the temperature required for graphitic transformation would probably render any application of the method to the latter purpose impracticable; the actual analogy is rather with certain early methods for the carbonizing and baking of lamp filaments and arc carbons.

MERCURY CATHODE CELL.

James Mactear, of London, patents a new cell belonging to this highly developed type. The essential features are the provision of an anode bell, the lower edges of which rest in grooves upon a plate which in turn rests upon the bottom of an external chamber containing water; this plate is further provided with a central well, and with radial grooves in its lower face, which afford passages for the circulation of mercury, means therefor being provided in the form of a rotary propeller within the well. In operation the inner cell is filled as usual with a solution of brine, and the mercury is flooded outwardly, passing beneath the anodes and through the groove which operates as a seal between compartments, then to return by its own gravity through the radial grooves to the well. There is little probability, however, that any construction of this type will displace the rocking cell of Castner.

IRIDESCENT COATING FOR COPPER ARTICLES.

A patent to Duncan Sinclair, of Coalbrookdale, England, deals with a method of forming brilliant and variegated surface colorations upon metals, through the agency of electrolytic deposits. This method, which is most simply operated by connecting the article to be coated as the anode in an alkaline solution of litharge, and carefully regulating the current, depends upon the deposition of exceedingly thin films of lead peroxide; such films give most brilliant interference effects resembling the changing tints in a soap bubble, and being, in fact, attributable to the same optical phenomena. Articles so colored have found much favor, especially in France, since the early days of galvanoplastics. Mr. Sinclair's improvement consists in adding to the alkaline lead solution a small amount of a salt of copper, concerning the effect of which the specification is silent. The claims, however, state that copper enters into the anodic deposit, and the record of the case shows it to be the inventor's belief that this metal, like lead, may separate at the anode—a statement which will scarcely command the assent of electrochemists. On the other hand, it is well known that in the electrolytic separation of cobalt from nickel the presence of copper in the solution is of great assistance in controlling the current and securing a slow and even deposition of the peroxid. Without doubt this is the function performed by the copper salt in the present case.

Tests of Cotton Mill Electrical Equipment.

Some interesting tests of economy in the use of electric power in cotton mills have recently been made at Columbia, South Carolina, in what is known as the Olympia Mill. This plant, which has only recently been completed, has been operated but a comparatively short period, and is somewhat notable for the reason that its machinery is not only driven by electric power applied directly, but that it contains

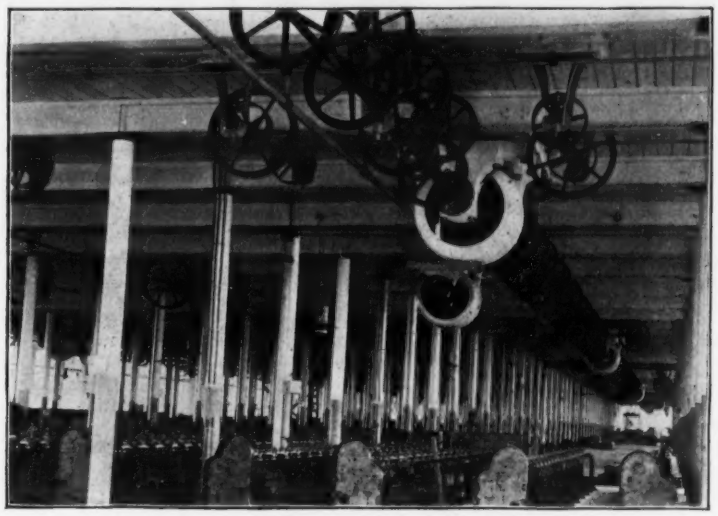


FIG. 1.—OLYMPIA MILL SHAFTING.

the largest number of spindles under one roof of any similar mill in the United States. In designing this mill, the engineers, Messrs. W. B. Smith Whaley & Co., of Columbia, were given *carte blanche* to install any system of power which they deemed most effective, and at the same time economical. After calculating upon the extent of the equipment and the probable service required, as well as the location of the plant, it was decided to install a series of motors in both the spinning and weaving departments, in place of rope or belt-driven machinery. The complete equipment of the mill is 104,000 spindles and 2,400 Draper looms, in addition to apparatus for making print cloth. At present about 85,000 spindles, 1,550 looms and supplementary machinery are being utilized, and with this equipment the tests were made. The electrical plant is General Electric throughout.

The spinning motors, as they are termed, are of 150-hp each and 575 to 580 volts; the three-phase, 40-cycle system being employed with a drop between the motor and switchboard of 1½ per cent. Each spinning motor serves 38 frames, or a total capacity of 10,032 spindles. The driving motors in the weave rooms are of 150 hp, for serving the complement of looms in operation. As will be noted in the accompanying illustration, the motors are suspended to the ceiling in the various departments in such a manner that belting and ropes are entirely avoided, while it is calculated that the waste of power is reduced to a minimum by the insulation and connections between the motors and other machinery.

The tests, which were made under the supervision of Mr. J. K. W. Davenport, electrical engineer of the Whaley Company, have been tabulated and give the following results:

With one section of 38 frames, the power in kilowatts required was 140, each kilowatt corresponding on an average to 81.8 spindles. Operating a series of 28 frames, 107 kilowatts are required, an average of 83.4 spindles per kilowatt. With 18 frames, 76 kilowatts are required, an average of 82.2 spindles, while with 8 frames, 44 kilowatts are required, an average of 75.7 spindles per kilowatt. The tests showed that one horse-power thus applied would furnish sufficient power for 68 spindles. The result of loom operation showed that with 638, 154 kilowatts are required, equal to 5.1 loom per kilowat, or 3.8 to one horse-power. To operate 549 looms, 136 kilowatts were required, equal to 5.3 looms per kilowatt, or 3.9 per horse-power. In all tests of the looms, ranging from the larger number, 638, to 45, proportionate results were obtained, in the case of the smallest series 46 kilowatts being required, or an average of 5.6 looms per kilowatt and 4.2 looms per horse-power.

From these tests the average is 68 spindles, or 5 looms per horse-power, while the mechanical and electrical losses or waste in conducting the current from the switchboard to the spinning frames is estimated at 12 per cent., and to the looms at 20 per cent.—an average loss of power of the equipment of 14 per cent. Compared with modern rope-driven machinery, the engineers estimate this to be from 11 to 17 per cent. less than where the former system is installed, while it is 25 per cent. less than in the case of power transmission by belting.

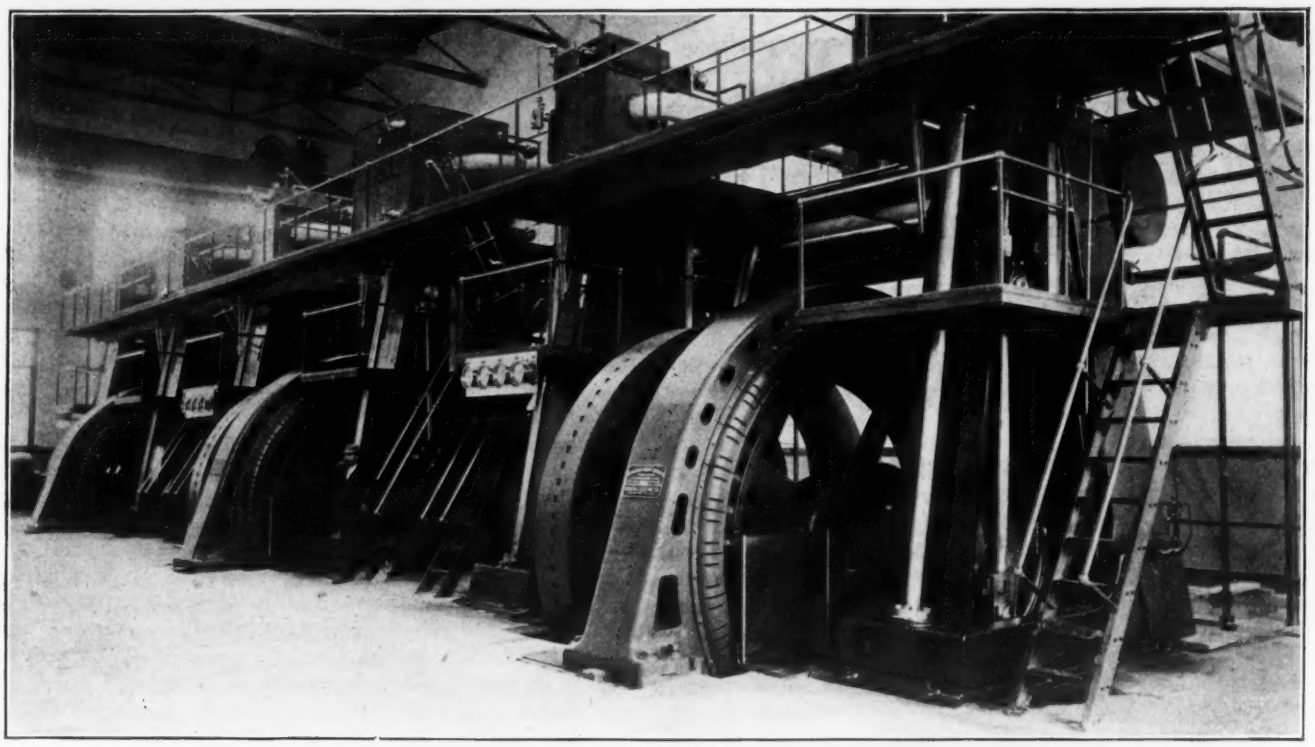


FIG. 2.—OLYMPIA POWER PLANT.

These calculations bear out statements made by other electrical engineers who have studied the application of power, especially in Southern cotton mills. Mr. H. H. Vreeland, president of the Metropolitan Street Railway Company, who has made several visits to the South and investigated the various systems of power, some time ago made the prediction that the larger mills, if electrically equipped could be operated at a saving of fully 25 per cent. compared with steam or water power transmitted by shafting and belting.

Distribution of American Exports.

A series of tables, compiled by the U. S. Treasury Bureau of Statistics, show that during the year 1901 52 per cent. of the manufactures exported went to Europe, 23 per cent. to North America, 6.6 per cent. to South America, 8.2 per cent. to Asia, 7 per cent. to Oceania, and a little less than 3 per cent. to Africa. The total value of manufactures exported to Europe was $215,000,000, to North America, other than the United States, $96,000,000; to South America, $27,000,000; to Asia, $33,700,000; to Oceania, $29,000,000, and to Africa, $10,500,000. Of the total exports of manufactures to Europe, amounting to $213,000,000, the largest item was iron and steel manufactures, to the value of $43,812,323, the next item in order of magnitude being copper manufactures, $41,454,074; scientific instruments, $3,840,763; cars and carriages, $3,718,381; india rubber manufactures, $2,187,453. To North America the largest item in the exports of manufactures was iron and steel, $43,518,293; cars and carriages, $3,577,765. To South America, iron and steel exports were $8,754,800. To Asia, oils, refined or manufactured, formed the largest item, $12,443,128, the next largest items being iron and steel manufactures, $8,992,967. To Oceania, the principal manufactures exported were iron and steel manufactures, $8,871,602. To Africa, iron and steel manufactures formed the largest item, $2,368,635, and cars and carriages, $543,674. Of the $117,319,320 worth of iron and steel manufactures exported, $43,812,323 went to Europe, $43,518,993 to North America, $8,992,967 to Asia, $8,871,602 to Oceania, $8,754,800 to South America, and $2,368,635 to Africa.

Water Power in Arizona.

Arizona, the dryest state in the Union, strange as it may seem, has several large and very important water power projects under construction. Lack of rain in the southwest serves as a great hindrance to development of water storage and developments in water power. In the Salt River Valley the towns of Phœnix, Tempe and Mesa are lighted with electricity, generated by small falls in the valley's canal systems. Sixty miles southeast of Prescott, on Fossil Creek, work has begun on a scheme that is destined to develop 2,000 horse-power, to be used mainly in the mines of central Yavapai County. A great power project is in incubation, based upon the damming of Bill Williams Fork, in extreme western Arizona. The new dam that is to store flood waters for the use of the Salt River Valley is to be built largely with the aid of water power, and a few miles above the reservoir it will supply power for a 3,000-hp transmission line to Globe and other central Arizona mining camps. This plant is being built by C. M. Clark.

The Grand Canyon of Arizona affords the greatest field for electricity generated by water power. Below the new Santa Fé Hotel, on the canyon brink, are Indian Garden Springs, which, in ordinary seasons, have a flow of nearly 100 miners' inches, that can be thrown over a cliff 3,000 feet high. In Cataract Canyon, the stream of flow usually approximating 10,000 miners' inches, makes three great leaps of 70, 144 and 250 feet, respectively, without reference to several thousand feet of drops from the Indian villages to the Colorado's channel.

Many plans have been mooted for developing the marvelous power of the Colorado, a stream which rises as much as 100 feet in flood time within the canyon. Floats equipped with great paddle wheels have been suggested, but it is probable that the river will some day be harnessed by means of tunnels that will "pick up" the fall of the stream. One such tunnel, at a point near Bass's Trail, and not over half a mile in length, driven through black granite, would cut off 12 miles of river channel, averaging not less than 12 feet of fall to the mile.

Dr. A. J. Chandler, of Mesa, Arizona, is engineering the latest Grand Canyon power plant. Dr. Chandler is the manager of the southwestern interests of Bowen & Ferry, the Detroit capitalists, and has made a success of a power-generating plant near Mesa. He has found an ideal location for power-generating works on the Kanal, Wash., not far from its union with the inner canyon of the Colorado about 70 miles north of Williams. It is stated that even 5,000 feet of fall can be found in a distance a little over a mile. The water supply is said to be ample and of remarkable regularity of flow. The only question seems to be that involving the carriage of the necessary heavy machinery down into the canyon and across the river, unless it be hauled southward from some Utah railroad point and lowered over the precipitous cliffs.

CURRENT NEWS AND NOTES.

CHICAGO DRAINAGE CANAL POWER.—The sanitary district board have ordered Chief Engineer Randolph to resume immediately the work of developing water power caused by the flow of the water in the sanitary district channel from the Chicago drainage canal at a point below Joliet. He is ordered to construct a dam and other works necessary to secure full control of the water power created at Hickory Creek.

ANOTHER TELEGRAPH TYPEWRITER.—A telegraphic dispatch from Utica, N. Y., of July 25, says: "About five years ago Charles E. Yetman, a Western railroad telegraph operator, conceived the idea of an attachment by which, while simply manipulating the keyboard of a typewriter as in ordinary typewriting, a message, mechanically correct, could be sent over telegraph wires. Mr. Yetman has become connected with the Remington Typewriter Company at Ilion, and it has decided to manufacture the invention, which he has just perfected. The machine will consist of a typewriter and telegraph instrument combined. The latter will be so arranged that by striking a key on a keyboard the Morse letters are made plain and accurate. Short wires connect the machine with the telegraph wire. The new machine has been tested on long and short lines, and operators pronounce it perfect. The Associated Press, it is alleged, will equip all of its offices with the Yetman machine, and arrangements have been made by the company's chief operator for a large number of machines.

MARCONI AND HIS CRITICS.—The jingo warfare in England against Marconi does not appear to relent. Mr. Henniker Heaton in a letter to the London *Times* recently ventured to defend the young inventor from the reproach of not being of English birth, saying, "I do not care if Mr. Marconi were found to be a full-blooded Huron or Liberian. The fact remains he has devoted his youth to working for England." He also remarked that Prof. Lodge's wireless telegram sent 200 yards compares poorly with Marconi's sent 2,000 miles. A friend of the knightly claimant replies through the same columns, asking, "Which of the two was the first to send a wireless telegram? Was it Lodge in 1894, or Marconi in 1896?" It would thus appear that the claim of Lodge to the coherer has been retired, and that he now rests on the futile laboratory experiment of 1894 as entitling him to the honors and emoluments of the art created by Marconi. A statement has also been circulated by Prof. Lodge's friends that Marconi had falsified as to the apparatus which he used in Newfoundland, the assertion being made that he employed a receiver invented by Solari. When the attention of Marquis Solari was called to this, he authorized the New York *World* to make the following statement: "*Saturday Review* was not correct; Newfoundland reception of signals from Cornwall was obtained independent of the use of the Solari coherer." What appears to be another incident of the warfare was the subject of sensational cable despatches to the New York papers of last Sunday. It was stated that Signor Marconi had applied for leave to amend an application for a patent so as to change it into an application for a patent communicated to him from abroad by Marquis Luigi Solari. Some of the London despatches interpreted this as an admission by Marconi that his entire system was invented by another. In the absence of details, it can only be surmised what amendment Marconi asked leave to introduce in the patent application. It appears, however, that there has been a heated controversy in Italy concerning the invention of a certain form of coherer. By some the invention of this coherer was attributed to one Castelli, a corporal in the Italian Navy, and by other to Marquis Solari, an officer in the same navy. In the concluding portion of Marconi's paper before the Royal Institution, as printed in our issue of July 12, there is reference to this dispute. Mr. Marconi said that the coherer was brought to him by Lieut. Solari, but that recently the invention was claimed by a signalman in the Italian Navy. He, therefore, wrote the Italian Minister of Marine, asking him to make an authoritative statement on the subject, and the following was the reply received: "The coherer has been with good reason baptized with the name of 'Italian Navy Coherer,' as it must be considered the fruit of the work of the various individuals in the Royal Navy and not that of one." In consequence of this authoritative statement, Mr. Marconi in his paper refers to the instrument as the "Italian Navy Coherer." It is possible that the controversy above-referred to may have some bearing on the amendment which Mr. Marconi asked to have made in his patent specifications.

LONDON'S WIRES.—Some people think of London as a city of underground wires. It is stated that there are 10,000 miles of overhead telegraph wires there. The number of telegraph messages received in London last year was over 6,000,000.

THE THUNDER STORM.—In the letter by Mr. A. G. Dell, entitled "The Thunder Storm," printed in our issue of July 12, two errors appear in proof-reading. In the sentence, "The storms are generally absent when the wind is from between the north and south in the Eastern states," the word "states" should have been "parts." In the sentence, "It is evident to my mind that heat, an initial charge, and a stratum of some kind are necessary for their production," the word "stratum" should have been "rotation."

A "CAR AHEAD" ORDINANCE.—Mayor Low, of Greater New York, has approved a second ordinance to stop the practice of compelling passengers to take the "car ahead" at certain times and points. A former resolution was held illegal, as it was not stated where the destination signs were to be placed. The ordinance provides that all cars shall have in plain view a sign denoting the destination, and that it shall be a misdemeanor to fail to run to such destination or to compel a passenger to take the "car ahead."

TELEGRAPHY IN ALASKA.—The government telegraph wire from Dawson to Ashcroft, making connection through the Canadian Pacific and other lines to the outside world, has been down most of the time since the latter part of May. The trouble has been chiefly from spring freshets taking down trees and banks and allowing the wires to fall. In many places storms have blown trees over the wires. The government will put a land cable over the most difficult mountains when snow begins to fall. It is desired to delay until that time so that rodents will not gnaw the insulation. In the cold weather last winter the wire was kept up well and worked most of the time after the fall trouble. The difficulties in the autumn were mostly south of Atlin, but at the present time are along the Yukon proper as well as to the southward in the wilderness of 1,800 miles to Ashcroft.

TELEPHONE EXCHANGE ON STILTS.—The exchange of the Youngstown (Ohio) Telephone Company, which has been on stilts for many months, while the building below was being rebuilt, has been lowered and now rests on the new block. The entire work of raising the top of the building, rebuilding the portion below and finally lowering the exchange portion into place, was effected without in any way interfering with the every-day operation of the exchange. The task of lowering the building was effected by huge screws. A trestle work of timbers resting on the steel beams of the second floor was built around the office, and into the top of this trestle were placed long bolts which were fastened into timbers extending under the office. The bolts were screwed up tight and held the office in place while the concrete floor was being laid to receive the exchange. When this was completed the work of lowering the suspended building was effected by simply unscrewing the large bolts.

HELPING A FELLOW-WORKER.—A rather good, or bad, story has recently been told, says *Cassier's Magazine* for August, illustrating the arrogance, ignorance or whatever it may be called of the executives of some of the trade unions in dealing with their members. It appears that while a workman was engaged in guiding a cable into a conduit in a building that was being wired, his fingers were caught between the cable and the walls of the conduit. The men at the far end of the conduit, unaware of their comrade's plight continued to pull upon the cable, seeing which an apprentice lad ran to his assistance and pulled back on the cable. A delegate of the union who had witnessed the affair and had expressed sympathy for the sufferer, reported him for violation of the rules of the order, and the latter was called to executive headquarters to explain his conduct. Notwithstanding that his fingers bore evidence to the extent of the accident he had undergone, he was fined "for allowing an apprentice to do helper's work, to wit, assisting a journeyman drawing wire into conduits."

SWEARING BY TELEPHONE.—At St. Louis, Mo., last week, Dr. Gettys, the physician, who was arrested for swearing through a telephone at a "central" operator, was given a spectacular trial in the police court, and at the conclusion fined $5 and costs by Judge Sidener. In giving his verdict, the court decided three unique points of law: First, Judge Sidener decided that profanity has no sufficient provocation. Profanity, he declared, is always aggressive, never protective, and is, therefore, never excusable by the plea of self-defense. The working principles of the law, it was further declared, have not been materially changed or invalidated by modern inventions; that crimes or offenses committed at long distance, such as the hurling of oaths at a person in another jurisdiction by means of the telephone, are amenable to the laws in the jurisdiction in which the offense is consummated. Dr. Gettys, in court, admitted the offense charged. "Did you swear over the telephone?" he was asked. "Yes, sir, I did. I cussed the system, not the employes." The court held that Dr. Gettys, on his own testimony, was guilty of using abusive language, and inflicted the fine of $5.

PROVIDENCE AND WORCESTER TROLLEY.—Another trolley, parallel to existing steam service, is being planned between Providence and Worcester by the Providence & Worcester Street Railway. The route will as nearly as possible form an air-line, making its length 40 miles; the only existing tracks that it will use will be those of the Union Railway, of Providence, and the Worcester Consolidated in securing an entrance into Providence and Worcester. The necessary franchises and locations in the towns traversed have been secured, and the remaining preliminary work is the securing of charters from the next Massachusetts and Rhode Island legislatures. The former charter is expected to be secured without difficulty, but in getting the latter the active opposition of the New York, New Haven & Hartford is already felt, in similar manner to the experience of the New York & Portchester line. The electric road will compete with the Worcester division of the New Haven under conditions disadvantageous to the latter. The distance on the latter is 50 miles, on account of a deflection to Woonsocket, against 40 miles on the trolley road; the running time of 1 hour and 45 minutes will be but 15 minutes faster, and the fare is $1.20, against 5 or little more cents for the electric line.

AUTOMATIC TELEPHONES IN FRANCE.—A special cable dispatch from Paris, of July 28, says: "After exhaustive tests the French government has adopted the automatic telephone invention of a Russian engineer. The apparatus does away with "Central" girls. The subscriber turns five disks, each numbered from 0 to 9, to form the number wanted, whereupon the correspondent is called automatically. If he is absent a sign soon appears saying: "Rang one minute; no answer," while the caller's number is registered at the other end, so that he may be called after the person sought returns. When the number desired is already "busy," a special buzz is immediately heard. In order not to dismiss all the telephone girls together, which might disturb the labor market, the new system will be introduced gradually. Three towns of moderate size are being equipped now—Limoges, Nimes and Dijon. A strange light is thrown on French methods by the fact that the apparatus would have been adopted two years ago if the police side of the government, which has always found the telephone exceedingly useful, had not insisted that secret conversations should be audible to a third party when desired."

NEW YORK STREET SIGNS.—President Cantor, of the borough of Manhattan, has been able to advertise for bids for the erection of street signs in New York, after a delay of considerable time. The Board of Estimate, after a discussion lasting several months, appropriated money for the signs. Then the president had to make the specifications, which were sent to the office of the corporation counsel. There they were either mislaid or lost, as they could not be found, and a new advertisement had to be drawn up. The bids will be opened on Wednesday, August 6, at 11 A. M., in the president's office. There are three contracts advertised. They are: (1) For furnishing and erecting and maintaining for three years 6,000 dark-blue enamelled metal street signs with clear-cut conspicuous white letters; (2) for furnishing, erecting and maintaining (without lighting) for three years on existing lamp-posts, fire-alarm posts, electric light poles, 1,200 sign boxes of two patterns, one for electric light and the other for gaslight, and (3) for furnishing, erecting and maintaining (without lighting) for three years, on existing poles and posts, 2,000 street sign boxes with a reflector attachment, the sign to have a reflector, deflector and radiator attachment. The specifications say explicitly that the signs become the property of the city, and the prices must include maintenance for three years. The sureties required are $2,000, $6,000 and $10,000, respectively.

TRACTION IN LONDON.—A cable dispatch received last week from London says: The bills affecting the Morgan and Yerkes underground railroads in London have been passed to a second reading by the House of Commons. The House of Commons has passed the bill authorizing J. P. Morgan's London United Electric Railways. Mr. Yerkes opposed the bill.

WIRELESS IN THE NAVY.—The U. S. Navy Department having decided to equip the fighting ships of the American Navy with a wireless system of telegraphy. Within a few days a board, consisting probably of five members, will be appointed to investigate the whole subject, to decide upon the system to be installed and to work out plans for the education and training of men to operate it aboard the ships.

MARCONI TOWERS AT CAPE BRETON.—The towers at Table Head, Cape Breton, were formally taken over from the building contractors on July 16th by the Marconi Wireless Telegraph Company. Everything in the matter of erection is now completed, and the wire work connections between the tower caps and the operating room are being installed by the electricians. The receiving apparatus is already in operation, and when the wire connections are made the station will be ready for the transmission of messages. Table Head, as its name imports, is a small barren promontory rising abruptly from the sea to a height of about 70 feet. The site has been illustrated in these pages.

N. E. L. A.—Miss H. Billings, assistant secretary of the National Electric Light Association, reports the following new members added in the past two weeks: Electric Light & Power Company, Adrian, Mich.; Corsicana Gas & Electric Company, Corsicana, Tex.; Shiawassee Light & Power Company, Corunna, Mich.; Fond du Lac Street Railway & Light Company, Fond du Lac, Wis.; Franklin Electric Company, Franklin, Pa.; Southwest Missouri Light Company, Joplin, Mo.; The Kokomo Railway & Light Company, Kokomo, Ind.; Bailey Light & Water Company, Madisonville, Ky.; W. A. Nolt, Oconto, Wis.; Ottumwa Traction & Light Company, Ottumwa, Ia.; The Telluride Power Company, Provo, Utah; Andrew F. Hall, Southbridge, Mass. A pithy extract is also being distributed from a letter of Mr. Chas. E. Scott, treasurer of the Bristol, Pa., Electric Light & Power Company, giving his experience as to the benefits accruing to small companies from membership in such a body.

DISPUTE OVER NIAGARA POWER.—The Ontario government has heard a lengthy argument regarding the dispute that has arisen between the Ontario Power Company and the Canadian Power Company in regard to the use of the waters of Niagara for power development. The Canadian Company is installing a very large plant, and the Ontario Company wishes to enlarge its first proposal by getting 25,000-hp additional from an intake at Dufferin Islands. This is 3,000 feet from the Canadian Power Company's intake, but its engineers say they are not in a position to state whether or not the Ontario Power Company's intake will injure the flow towards their own until they see detailed plans. They accordingly asked the government to require the production of plans by the Ontario Power Company of the proposed intake at Dufferin Islands. The Ontario Power Company was represented by B. R. Paine, J. J. Albright, General Hayes and General Bissell, of Buffalo, and Z. A. Lash, of Toronto; the Canadian Power Company by William B. Rankino and the company's counsel, Mr. W. Nesbit. The government reserved its decision.

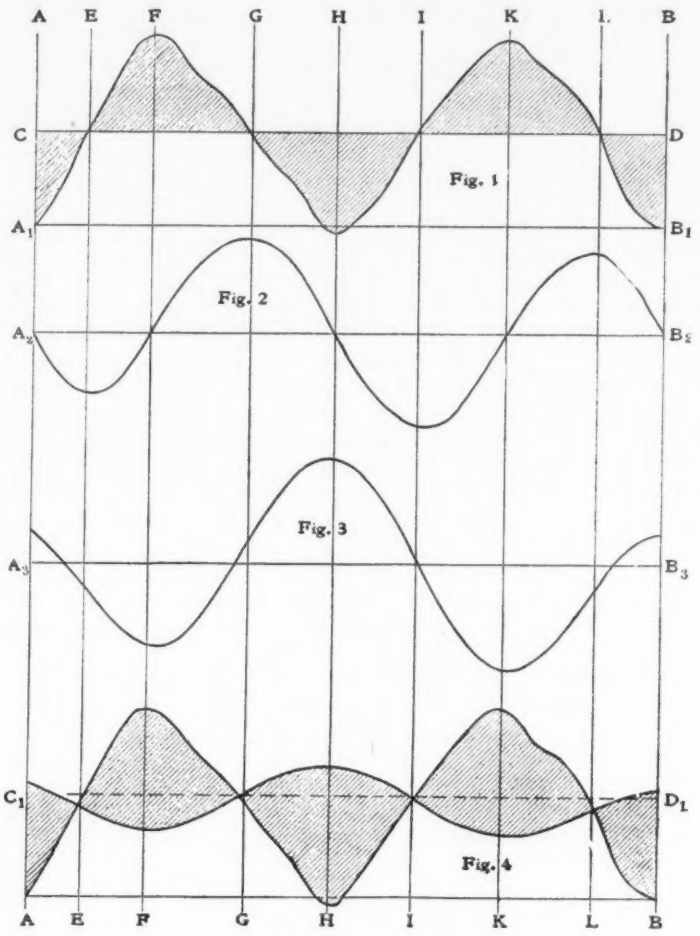
WIRELESS TELEGRAPHY AT SANDY HOOK.—Rear Admiral Rodgers and the naval board, of which he is chairman, have selected a site for a government wireless telegraph station, on the Navesink Highlands, overlooking Sandy Hook. The tower is to be placed near the north beacon of the famous Twin Lights and close to the Postal Telegraph Observatory. This is the first land station selected by the Navy Department for sending wireless messages of an official character. The new tower will be of wood and entirely independent of the American Wireless Company's new tower, which is being built a short distance from the light-house. It is understood to be the intention of the Navy Department to have direct communication with the Brooklyn Navy Yard, as well as with vessels far out at sea, and if the experiment is successful wireless telegraph stations will be built for the government in several places on the East and West coast. The new station will contain all the latest improvements of Marconi.

LETTERS TO THE EDITORS.

Paralleling of Alternators.

To the Editors of Electrical World and Engineer:

Sirs.—I read with great interest in your issue of March 31st, the abstract of Mr. H. E. Longwell's paper, "Paralleling of Alternators." In some respects I have quite the same opinion as Mr. Longwell, and a paper referring to "Paralleling of Alternators, Especially if Driven by Large Gas Engines," which I read before the Hanoverian Electrotechnical Society on January 23d, of this year, contains some paragraphs and figures which are nearly the same as those of Mr. Long-



LONGWELL DIAGRAM.

well. I will add that it is impossible that Mr. Longwell had knowledge of my paper, for it was published in three parts, not earlier than the month of May, the 15th, 22d and 29th. (*Elektrotechnische Zeitschrift.*) But I am happy that Mr. Longwell comes to the same result as an electrical engineer handicapped by a "formidable array of mathematics, Greek letters and scientific terms."

I concede to Mr. Longwell that it is quite possible to understand without mathematics that the synchronizing force increases the angular variation in an engine. I showed the same with figures similar to those of Mr. Longwell, both with theoretical sinoidal diagrams of crank forces and with practical diagrams of steam and gas engines. But if one uses only these diagrams, the calculation of the total amount by which the synchronizing force increases the displacement is indeed, to use Mr. Longwell's words, "a tedious and somewhat involved process." But with a little "array of mathematics," and with a polar diagram of oscillating and damping, I was able to show that the total increase of the degree of irregularity, also the increase of the oscillating velocity and variation, and the resulting increase of the synchronizing force is:

$$\frac{1}{1-q}$$

where q is the proportion between the first synchronizing force and the oscillating force of the original crank-force diagram. If, in Mr. Longwell's Fig. 4, the curve, *C, D,* of the first synchronizing force is in a proportion

$$\frac{1}{10}, \frac{1}{5}, \frac{1}{3}, \frac{1}{2}, \ldots$$

to the original oscillating force of the curve, *A, B,* the total increase of irregularity, etc., is

$$\frac{10}{9}, \frac{5}{4}, \frac{3}{2}, \frac{2}{1}, \ldots$$

Therefore, I concede to Mr. Longwell that one must not ask the same angular displacement for alternators with different short-circuit currents. But one must also not ask the same variation from engines with different crank-force diagrams. A double steam engine must not have so great a variation as is allowed for a single steam engine, and the latter must not have the same as a two-cycle gas engine. A variation of 3 or 4 electrical degrees, which does not matter in a gas-driven alternator with a very great oscillating force in the crank-force diagram, and with a heavy flywheel, may give enormous trouble in an alternator driven by a twin steam engine with very low oscillating forces in the original diagram and with a light flywheel.

I cannot give here more particulars of my theory, but an English translation of my paper will soon be published in a London journal.

G. ROSENBERG.

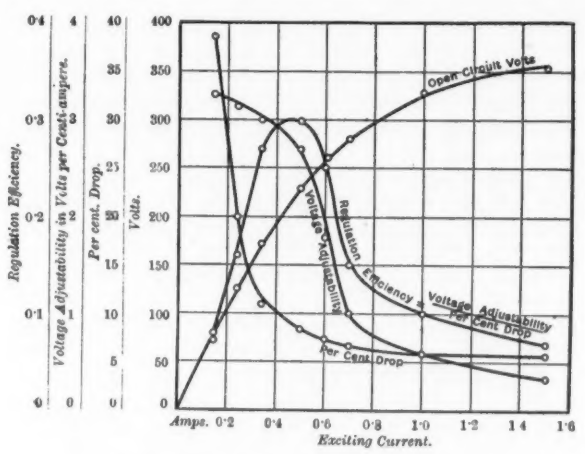
HANOVER, GERMANY.

DIGEST
OF
CURRENT ELECTRICAL LITERATURE.

DYNAMOS, MOTORS AND TRANSFORMERS.

Standardization of Machines.—In 1901, a special committee of the Association of German Electrical Engineers presented a report on the standardization of electric machines, with a proposed set of rules, as was duly noticed in the Digest. This set of rules was then adopted for one year on trial. The same committee has now presented a recent report, in which they propose some modifications of the former rules and also some new suggestions. They are reprinted in full, together with an explanatory article of Dettmar. Under definitions, it is proposed that by the simple term tension (spannung) of the three-phase currents should be meant the effective voltage between two of the three main conductors, while by the star tension or star voltage is to be meant the voltage between one wire and the neutral point. The transformer ratio is to mean the ratio of the tensions at no load. Frequency is to mean the number of complete periods per second. The old rules concerning the measurements of the rise of temperature have been modified in details; it is now required to determine it by measuring the increase of resistance in the following cases: in the field coils of direct and alternating-current machines, in the armature coils of single and polyphase alternators with stationary armature, also in the stationary part of induction motors. The temperature rise is determined with the thermometer in the armature of direct-current machines and converters, in the armature of alternators and synchronous motors with stationary field, in the revolving parts of induction motors, and in all coils of transformers. If nothing else is said, inductive voltage variation refers to a power factor of 0.8. As an appendix to the rules, a set of suggestions is given. The frequency should be 25 or 50. For the speed of single or polyphase alternators the following values are suggested: 75, 83, 94, 107, 125, 150, 166, 188, 214, 250, 300, 375, 500, 600, 750, 1,000, 1,500, 3,000; they correspond to numbers of poles between 2 and 80. For the voltage of direct-current system is suggested 110 for the motor, 115 for the generators; 220, 230, 440, 470, 500, 550; for the voltage of single and polyphase systems 110, 115, 220, 230, 500, 525, 1,000, 1,050, 2,000, 2,100, 3,000, 3,150, 5,000, 5,250. If one and the same direct-current generator has to give a higher voltage at constant speed, this can be accomplished by increasing the excitation, if the power is not increased; generally the increase of voltage, thus accomplished, should not be more than 30 per cent. of the normal voltage; a greater increase of voltage is to be obtained by increasing the speed. If one and the same direct-current dynamo has to give a lower voltage at constant speed, this can be accomplished by decreasing the excitation, as long as the power is diminished in the same ratio as the voltage; generally, the decrease of voltage thus accomplished should not be more than 20 per cent. of the normal voltage; a further decrease of the voltage is to be obtained by decreasing the speed. If one and the same direct-current generator has to give at times a lower, and at times a higher e. m. f. than the normal e. m. f., this can be accomplished by changing the excitation as long as, at the higher voltage, the power is not increased, and that at the lower voltage the current is not increased, and that the difference between maximum and minimum voltage is not more than 45 per cent. of the latter. Further variations of the voltage are to be accomplished by variations of the speed.—*Eelk. Zeit.*, June 5.—At the annual meeting of the Association of German Electrical Engineers the report of the committee and the set of rules were accepted for one year on trial. Next year the committee will report again, and if the rules have proved satisfactory in practice, they will be definitely adopted.—*Elek. Zeit.*, June 26.

Normal Saturation of Alternator Fields.—BEATTIE.—An article on the definition of the "normal saturation" of an alternator field. An alternator is considered good if it has a small percentage voltage drop and high voltage adjustability, but bad if it has a large percentage drop and low voltage adjustability; the voltage adjustability meaning the capability of varying the terminal pressure by altering the exciting current. It is, therefore, reasonable to take the ratio of the voltage adjustability to the percentage voltage drop as a measure of the "regulation efficiency" of the machine. In general, this regulation efficiency is low at low degrees of saturation as well as at high, and for some intermediate saturation will have a maximum value. He suggests the adoption of that degree of saturation which makes the regulation efficiency a maximum, as a useful working definition of normal saturation. He gives the result of a test of a small alternator for experimental purposes. They are given in the adjoining diagram. The curves show how the regulation efficiency reaches a maximum with an exciting current of



SATURATION OF ALTERNATOR FIELDS.

0.45 ampere, which is, therefore, the current required to produce normal saturation. The corresponding normal voltage and normal voltage drop are 210 volts and 9.2 per cent., respectively. The regulation efficiency as thus defined does not form, of course, a strict basis for the comparison of the regulating qualities of different machines, but it is a very convenient way of expressing the degree

of saturation in a given machine. Thus from the curves one may say that with an exciting current of 1 ampere the machine is oversaturated to such a degree that the regulation efficiency is reduced to one-third of its maximum. He says it would be interesting to know exactly the degree of oversaturation at which modern alternators are generally worked.—Lond. *Elec.*, July 11.

REFERENCES.

Armature Reaction and Voltage Drop in Dynamo Electric Machines.—Picou.—An illustrated paper read before the International Society of Electricians, in Paris. For the predetermination of the voltage drop in alternators, Behn-Eschenburg, Rothbert, Blondel and Potier have developed different methods. The present author co-ordinates these different methods, by connecting them more intimately with the theory of magnetic circuits; he thus obtains a generalization which permits the application to direct or alternating-current machines as well as to transformers. The paper is long and highly theoretical and cannot well be abstracted here.—*Bull. Soc. Int. des Elec.*, June.

Compound Alternators.—Boucherot.—His very long illustrated paper in full, on his system of compounding alternators, read recently before the International Society of Electricians, in Paris. An abstract of the paper was noticed recently in the Digest.—*Bull. Soc. Int. des Elec.*, June.

Elimination of Harmonics in Alternators.—Guilbert.—A mathematical article. For eliminating the higher harmonics in the e. m. f. waves of alternators, methods have been suggested repeatedly which are analogous to those applied in direct-current dynamos in order that the distribution of the tension between two brushes of opposite sign may become more sinusoidal. The mathematical theory of two methods of this kind and of their application in alternators is given.—*L'Eclairage Elec.*, June 14.

Tramway Motors.—See the abstract of a paper of Rausch under International Tramway Union Congress, under Traction.

Power.

Electrical Power in Manufacturing Plant.—A long and well illustrated description of the electrical equipment of the Nordbery Manufacturing Company's plant at Milwaukee. The main products are mining and other heavy machinery. The plant is electrically driven throughout, and, with the exception of those in the tool room, all tools are fitted with individual motors. Direct current is used, and to get a wide variation of speed, the multiple voltage system is used, combined with field control. The ratio between the highest and the lowest speeds is 7.5 to 1. The full voltage is 250. By means of a compensator or equalizer the total voltage is divided into three steps. This machine consists of two machines mounted on one base, and with the same shaft, one having two armature windings and two commutators, the other one armature winding and one commutator. Four wires are used for distribution.—*Am. Mach.*, July 3.

REFERENCES.

Transmission Plant.—McConnon.—An illustrated description of the power plant of the Missouri River Power Company, at Canyon Ferry, Montana, and its 50,000-volt transmission line.—*Jour. of Elec.*, June.

Water-Power Plants.—Eastwood.—A paper read before the Pacific Coast Electric Transmission Association, on "The Hydraulic End of Power Transmissions."—*Jour. of Elec.*, June.

Traction.

REFERENCE.

Tramway Exposition.—The first part of a well illustrated description of the exhibits at the second International Tramways and Light Railways Exhibition in London, comprising tramcars, generators, motors, conduits, multiple-unit systems, switchboards, brakes, rail-joints, etc., of British companies.—Lond. *Elec.*, July 4.

Installations, Systems and Appliances.

Regulating the Current of a Gas Engine Driven Dynamo.—Lauriol.—A paper read before the International Society of Electricians, in Paris. In a French central station one gas engine drives two direct-current dynamos by belts, one of the Henrion type with series excitation, the other of the Gramme type with separate excitation. Each dynamo supplies a circuit of arc lamps in series. The current supplied from the Gramme dynamo shows fluctuations in the light of the lamps, synchronous with the cycle of the motor; in the other arc circuit there are no fluctuations of the light. The difference is believed to be due to the fact that the Henrion dynamo has a much greater moment of inertia than the Gramme dynamo; the former, therefore, will not follow exactly the speed variations of the gas engine. To suppress the variations in the Gramme dynamo circuit, Girard has successfully applied the following remedy after a series of experiments. By means of a rheostat, inserted in the circuit of excitation and operated by the distributing-shaft of the engine, the resistance of the exciting circuit and, therefore, also the field produced are periodically varied.—*Bull. Soc. Int. des Elec.*, June.

REFERENCE.

Automatic Switches for Pumping Installations.—An illustrated article on switches for automatically starting pumps when the water in a reservoir has fallen below a certain level, and interrupting the circuit when the reservoir is filled.—*Elek Anz.*, July 3, 6.

Wires, Wiring and Conduits.

REFERENCES.

Armored Cables.—Rochas.—The first part of a mathematical discussion of the geometrical problems involved in the theory of the armoring of submarine cables with iron wires.—*L'Eclairge Elec.*, June 7.

Laying a Cable in Earth.—An illustrated description of a plough for laying an electric cable in earth to a depth of 70 to 80 cm. below the surface. It will be used for laying a telegraph cable in Africa, and was built by a French telegraph and telephone company.—*L'Ind. Elec.*, May 10.

Electro-Physics and Magnetism.

Zeeman Effect.—Riecke.—A paper in which he attempts to harmonize the values for the ratio of the electric charge to the mass of an electron, obtained from the Zeeman effect, with that obtained from cathode rays, more closely than has hitherto been possible. The fact that some spectrum lines are divided into triplets and others into more complicated structures shows that the above ratio cannot be the same for every mode of vibration. By means of simple dynamical reasoning he deduces a formula for the difference in the frequencies of the two extreme components of a triplet. Zeeman applied this formula to the cadmium triplet and found the above ratio divided by the 15th power of 10 to be 743 electrostatic units per gram. Similar values may be obtained from the mercury lines. In the mercury spectrum, the first line of the second subordinate series is divided into nine components showing an equal interval of frequencies. Any pair of them gives the above value for the ratio. It differs from that obtained from cathode rays, which is 559. But the author points out that the isolated mercury lines, which form true triplets, give the value 558.5. He concludes that the same is the case for all true triplets, and that the cadmium triplet is not a triplet at all, but consists of six lines close together.—*Phys. Zeit.*, June 15; abstracted in Lond. *Elec.*, June 27.

Electron Hypothesis and Theory of Magnetism.—Voigt.—A paper in which he analyzes the possibility of obtaining from the theory of electrons an explanation of paramagnetic and diamagnetic phenomena. It is assumed that the "translation velocities" of the electrons are small in comparison with the "velocity of radiation"; and on this assumption some important conclusions are arrived at. "It is assumed in the first place, in accordance with the analogy of the unresisted molecular currents of the older magnetic theories, that the electronic motions are undamped, and it is then found that changes in the velocities of the electrons in consequence of the formation of magnetic fields will not give rise to magnetic phenomena." The effects of damping, which play so important a part in the optical phenomena of dispersion, are then considered, and the author shows that "if the electronic motions of a body in a constant magnetic field are subject to damping, while at the same time the energy dissipated is supplied by means of any completely irregular series of impacts, as, for example, with other electrons, or with ponderable molecules, so that the mean value of the energy tends to a fixed limits, the body will exhibit paramagnetic or diamagnetic properties according to whether the mean energy of the electrons after the impacts, is mainly potential or mainly kinetic."

Finally, it is shown that the presence in a magnetic field of rotating bodies carrying electric charges, can only give rise to diamagnetic phenomena when they experience no resistance. Charged bodies, on the other hand, rotating against resistance and having their energy loss made up by irregular impacts, may give rise to either paramagnetic or diamagnetic phenomena.—*Ges. Wiss. Goettingen, Nachr. Math. Phys. Kl.*, 3, p. 169, 1901; abstracted in *Science Abstracts*, June.

Phenomena with Three Variable Quantities.—HOSPITALIER.—A note presented to the International Society of Electricians, in Paris. In a great number of electric phenomena there are three variable quantities. The graphical method for studying them has generally been by means of a series of curves, each of which curves gives one variable quantity as a function of the second, the third being constant, while for the different curves the third or constant quantity has different values. For more complicated cases this method is not to be recommended. He recommends, instead, representing one variable quantity as a function of the two others by a surface in space, produced by means of bent iron wires. He suggests using this method for the study of various alternating current problems, for instance the variation of the excitation of a constant voltage alternator as a function of the current and of the phase difference between current and e. m. f., etc.—*Bull. Soc. Int. des Elec.*, May.

REFERENCE.

Conductivity.—MEWES.—A very long article on resistivity and conductivity of metals, alloys and electrolytic solutions. He first discusses the two theories developed by Liebenow and by himself, on the conductivity of different materials at the same temperature. The second part of the article deals with the change of the electric conductivity with the temperature. The article is highly theoretical and cannot well be abstracted.—*Elektrochem. Zeit.*, May, June, July.

ELECTRO-CHEMISTRY AND BATTERIES.

Calcium Carbide.—GIN.—An article on the reactions in the formation of calcium carbide. It is known that the gases developed in different parts of calcium carbide furnaces contain both free oxygen and free calcium. The amount of free oxygen increases with the current density; it is formed at the places of highest temperature. The calcium vapors come from places of lower temperature. The development of oxygen causes the burning of the electrodes immediately below the surface of the molten bath. The fine dust which is deposited on the furnace consists nearly entirely of calcium. To explain this, he calls attention to the experiments of Berthelot, which prove that carbonous oxide is dissociated at high temperatures, also to the fact that in the industrial manufacture of carbide it is not the formula of Bullier which is used for the charging mixture, but there is a surplus of calcium oxide; and finally he calls attention to the fact that the contents of the furnace is a series of layers in which the temperature rapidly decreases from the inside to the outside. In these layers different chemical equilibria are formed, the reaction being the more endothermic, the higher the temperature. When in the hottest places the temperature is so high that the carbonous oxide is entirely dissociated, the formation of calcium carbide consists of a simple substitution of the oxygen in calcium oxide by carbon, with the development of free oxygen. Calcium vapors are developed at the boundary surface of calcium oxide and calcium carbide; two formulas are given by the author.—*Zeit. f. Electrochemie*, June 19.

Electrolytically Produced Compound of Sulphur and Copper.—RIEDER.—An article in which he describes the following phenomenon. The end of a copper bar was surrounded with a non-conducting sulphur cylinder, and then placed as cathode in a copper-plating bath, so that part of the copper bar above the sulphur is also immersed in the solution. After 20 hours, it was found that the copper bar had been somewhat eaten away at the point where it was in contact with the sulphur, while the sulphur cylinder near this point had increased, its surface having become blue-black. This is due to a compound of copper and sulphur, which is a good conductor and is decomposed in dilute sulphuric acid, hyrosulphuric acid being formed. He believes that this compound acts like an electrolyte, so that the formation of this compound progresses gradually into the internal parts of the sulphur. If the sulphur is mixed with other suitable materials, for instance zinc dust or sulphide of copper, etc., then when brought as cathode into a copper bath, the formation of the blue-black begins at once over the whole surface of the sulphur block. He used this copper sulphur compound as one electrode in a cell, while the other electrode is of zinc, and the electrolyte is ammonium chloride mixed with zinc chloride. At the zinc electrode zinc goes into the solution and forms zinc chloride, while at the other electrode hydrosulphuric acid is formed, which reacts upon zinc chloride in the solution, zinc sulphide being formed.—*Zeit. f. Elektrochemie*, June 5.

Faraday's Law.—BOSE.—An abstract of a paper on the range of validity of Faraday's law. To test the accuracy of the law, no salt should be used, the cation of which is capable of existing with two different valencies, as a possible disturbing factor then enters, for instance that due to the reaction of one bivalent ion with one atom giving two monovalent ions. The deviations found in the electrolysis of silver salts (0.0001 of the total weight of silver deposited) are due to secondary reactions, an important one of which is attributed to oxygen occluded by the platinum electrode. Faraday's law may be regarded as an absolutely exact law of nature. The current which passes through an electrolyte is entirely conducted by the transportation of material, and there is no evidence of "metallic conduction." He considers Faraday's law as comparable with Dalton's law of multiple proportions as far as exactness is concerned, and views it as an extension of Dalton's atomic laws.—Lond. *Elec. Eng.*, June 13.

Electrolytic Formation of Peroxide of Lead from Metallic Lead.—PETERS.—Continuations of his very long serial, the first parts of which were abstracted in the Digest, Jan. 25. As in the former abstract, the numbers in parentheses after each electrolyte give the grams of peroxide which he obtained for 100 amp.-hours, with a current of 0.6 ampere and a surface of 144 sq. cm. (Theoretically, 100 amp.-hours could form 222 grams of lead peroxide.) The following electrolytes are discussed: 30 gr. bichromate of potassium and 12 cc. concentrated sulphuric acid to 1 liter water (1.1575 gram peroxide of lead); 20 gr. chromic alum and 12 cc. concentrated sulphuric acid to 1 liter water (1.0070 gr.); 150 gr. sulphate of sodium, free of water, sp. gr. 1.12, to 1 liter water (0.6927 gr.); 150 gr. of ammonium sulphate, sp. gr. 1.070 to 1 liter water (0.7284 gr.); 150 gr. of crystallized magnesium sulphate to 1 liter water (0.1147 gr.); 600 gr. of crystallized magnesium sulphate to 1 liter water (0.1181 gr.); 900 cc. 15 per cent. solution of magnesium sulphate mixed with a solution of 30 gr. ammonium sulphate and 20 gr. crystallized hydroxide in 100 cc. water (34.9311 gr.); 30 gr. crystallized magnesium sulphate and 20 gr. sodium sulphate, free from water, to 1 liter water, sp. gr. of solution 1.026 (3.5432 gr). The serial is to be continued.—*Centralbl. f. Accum., Apr.* 1, May 1, June 1.

Tests of French Storage Batteries.—An account of a long series of tests of French storage batteries for use in the French Navy; 21 batteries, made by 13 different firms, were tested; 11 had pasted plates throughout, 9 had positive Plante plates and negative pasted plates; 1 had both plates of Plante formation. All the batteries were connected in series and were discharged or charged together. A discharge was stopped when the e. m. f. of any cell had dropped to 1.65 volts; every cell which dropped to 1.65 volts in less than half an hour was removed from competition. At the end of 251 discharges five batteries were still in competition, four of which had pasted plates throughout, while the fifth had positive Plante plates and negative pasted plates.—*Centralbl. f. Accum.*, June 15.

REFERENCES.

Tin From Tinned Iron Scrap.—MENNICKE.—A very long article on the electrolytic recovery of tin from tin scrap in sodium hydroxide solution. The tin scrap is used as anode and pure tin is deposited on the cathode, while the iron of the scrap with other impurities remains in the anode sludge. He gives the formulas of the reactions and discusses at great length practical questions concerning the process.—*Zeit. f. Elektrochemie*, May 22, June 5, 12.

Electro-Analysis.—HANAMAN.—An illustrated description of an apparatus for electro-analytic purposes. The different devices and accessories, necessary for this purpose, are combined in one apparatus.—*Zeit. f. Elektrochemie*, June 19.

Resistance Furnace.—GIN.—An article in which he gives some formulas for approximately determining the temperature and efficiency of an electric resistance furnace.—*Elektrochem. Zeit.*, May.

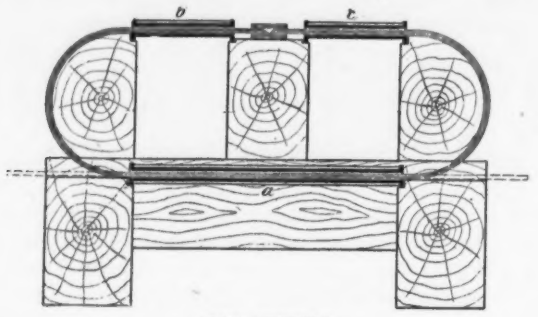
Calcium Carbide.—MUENSTERBERG.—An article on the present conditions of the calcium carbide and acetylene industry. He believes that acetylene is the light of the future in small cities and in isolated buildings.—*Rev. Gen. des. Sc.*, June 15.

Theory of Electrolysis.—Platner.—The first part of a mathematical article on Maxwell's electromagnetic theory and its application to the phenomena of electrolysis.—*Elektrochem. Zeit.,* June.

Dusseldorf Exposition.—An article on storage batteries exhibited by three German manufacturers.—*Centralbl. f. Accum.,* May 15, July 1.

Units, Measurements and Instruments.

Iron Testing.—Richter.—An illustrated description of a new method of testing iron, which has proved satisfactory in the works of Siemens & Halske, of Vienna. Iron sheets are tested as a whole in the form in which they come from the mill. In this way an average value is obtained of the quality of the iron at different parts of the sheets. The apparatus consists of three magnet coils, *a b c,* which are held in position by means of a wooden frame, as shown.



IRON TESTING.

The sheets to be tested are passed through the coil *a,* then bent upwards at both ends and the ends pushed through the coils *b* and *c.* The only air-gap in the iron circuit is where the ends touch. To get a good average value, at least four sheets are tested at the same time, which are insulated from one another by means of tissue paper. Only the ends of the internal sheet touch each other, while the ends of the other and outer sheets are slightly separated from one another, as shown in the figure. At this point two small sets of small iron sheets are clamped above and below the terminals of the large sheets; they are pressed together against the ends of the large sheets to close the magnetic circuit. The preparations for the tests require 15 minutes and no great accuracy is necessary in putting the sheets into the apparatus, in order to remain within the allowed limit of error of 3 per cent. Nothing is said about the way the measurements are made.—*Elek. Zeit.,* June 5.

German Reichsanstalt.—A long abstract of the official report of the work of the German Reichsanstalt in 1901. The platinum resistances which have so far been used for measuring low temperatures have now also been calibrated at higher temperatures up to 500° C. For two sorts of platinum the following formulas were found:

$$W = W_0 (1 + 0.003923\ t - 0.000000485\ t^2)$$

and

$$W = W_0 (1 + 0.003966\ t - 0.000000582\ t^2).$$

They are correct within −100° and +500° C., with an accuracy of ±0.15 per cent. At lower temperatures there are greater discrepancies, which are above 2 per cent. at the temperature of liquid air. The different sets of standard resistances have again been compared, and have been found to be very constant. The Deprez-d'Arsonval type of galvanometer has been found well suited for exact resistance measurements and for ballistic measurements. Many measurements have been made with standard cells, and the cadmium (Weston) cell has been found to be reliable, in spite of the claims of Cohen to the contrary. Extended researches have been made on the behavior of mercurous sulphates; 378 instruments, 7 motors and transformers, and 24 materials have been tested. Arrangements have now been made by the Reichsanstalt officials to test the behavior of electric meters of different makers at the place where they are installed; these meters are first carefully tested in the laboratory and then 20 to 30 of each type are installed at various consumers and are accessible only to Reichsanstalt officials. The equipment of the alternating and three-phase current laboratory has been completed, so that potentials of 3 × 5,000 volts and currents up to 3 × 1 000 amperes are available. For testing watt and current meters, a double three-phase machine has been installed, the revolving magnets of a 5-kw and a 1.5-kw, three-phase machine are mounted on the same axle; the armature of the 5-kw machine is fixed, as usually, while that of the 1.5-kw machine can be displaced against that of the larger one by an angle up to about 100 degrees. The larger machines gives the current for the main current coils of the current and watt meters, the smaller one for the voltage coils. In this way the phase difference between e. m. f. and main current can be varied at will by displacing the armature of the smaller machine. Moreover, a switch is provided which enables one to change the three conductors of the smaller machine so that phase differences of 60 degrees can be instantaneously obtained; 228 resistances, 125 Clark standard cells, 39 Weston standard cells, 87 primary batteries and 6 storage batteries were tested. In the magnetic laboratory, three instruments were examined and 57 materials tested. Extended researches were made concerning the determination of hysteresis and eddy current losses; 518 Le Chatelier thermo-cells, 5 thermo-cells of platinum and platinum-nickel and 7 thermo-cells for the use at low temperatures were tested.—*Elek. Zeit.,* June 5, 12.

References.

Analyzing Alternating Waves.—Loppe.—A mathematical paper on a method of decomposing an alternating wave into a sum of sine waves.—*L'Eclairage Elec.,* June 28.

Compass.—Meldau.—A mathematical article on the deviation of the compass needle on board of iron ships.—*Phys. Zeit.,* June 1.

Röntgen-Ray Apparatus.—Rollins.—A continuation of his illustrated article. He describes the apparatus for supporting a photographic plate and makes some remarks on the capacity and potential in coils used for exciting Röntgen-ray tubes.—*Elec. Rev.,* June 21.

Telegraphy, Telephony and Signals.

References.

Telegraphy and Telephony.—Kohlfuerst.—A brief summary of the progress made in 1901 in installations of submarine telegraphy, wireless telegraphy and long-distance telephony.—*Zeit. f. Elek.,* June 1.

The Coherer in Submarine Telegraphy.—Guarini.—The first part of an article, in which he discusses chiefly with reference to his own patents, the use of the methods of tuned wireless telegraphy to the realization of multi-communication in submarine telegraphy.—Lond. *Elec. Rev.,* June 27.

Multiple Telegraphy.—Anizan.—A continuation of his well-illustrated article on the Mercadier system of multiplex telegraphy.—*Jour. Teleg.,* June 25.

Theory of Wireless Telegraphy.—Kareis.—An illustrated article on "the field of force in wireless telegraphy." He discusses the views advanced by Taylor and Lecher that the earth's surface, or still better the surface of the water, acts like a wire, the Hertzian waves following it with oscillations perpendicular to this surface.—*Zeit. f. Elek.,* June 22.

Electric Clocks.—Richard.—An article giving brief illustrated descriptions of new electric clocks of seven different inventors.—*L'Eclairage Elec.,* June 21.

Statistical.—Articles on telegraphy and telephony in Austria in 1900, and on telegraphy in Italy in 1898-99.—*Jour. Tel.,* June 25.

Miscellaneous.

References.

Dusseldorf Exposition.—Seyferth.—A long illustrated description of the exposition, the systems of power generation and distribution, and the electrical exhibits.—*L'Eclairage Elec.,* June 14, 28.

Goetze.—A long and very well illustrated description of the exhibits referring to the use of electricity and power gas in mining and metallurgy.—*Glueckauf,* June 28.

Loppe.—An article on the electric power generation and distribution, and on the electrical exhibits.—*L'Ind. Elec.,* June 25.

Statistics of German Patents.—A long abstract of an official report of the German patent office.—*Elek. Anz.,* June 8, 12, 15, 19.

New Books.

DIE FUNKENTELEGRAPHIE. By A. Slaby. Berlin: Leonhard Simion. 119 pages, 32 illustrations.

A number of important papers by Dr. A. Slaby, of the Technical High School, of Berlin, and inventor of the wireless telegraph system which bears his name, has been compiled in book form, and makes an interesting addition to the literature of the art.

The title of the volume is "Spark-Telegraphy," the name favored by the doctor as the most appropriate for the designation of the spark-gap and coherer system in use to-day. The work consists of four principle papers read before various societies, together with two inserted pamphlets relating to the graphic and mathematical elucidation of the Slaby theory of wireless telegraphy.

The first paper is entitled "Spark-Telegraphy," from whence the book derives its name. It is a history and resumé of the state of the art to 1897. It includes the rectilinear wave theory from the free end of the oscillator, the process of cohesion under the action of electric waves, and a plate on which is reproduced the tapes from a Marconi and a Slaby receiver, and showing the rapidity of the latter.

"The Application of Spark-Telegraphy to the Marine Service" is the second paper, and was read before the Technical Shipbuilding Association, Dec., 1897. Dr. Slaby recites the requirements of the merchant-marine as well as of the navy, and considers the nature of the antennæ, and from theoretical considerations he evolved a special form of equipment especially adapted to the trying conditions involved in armored vessels.

In his third paper Dr. Slaby reviews the various theories advanced to account for the transmission of energy in wireless telegraphy, but naturally devotes the principle part of the paper to a discussion of the wave system he evolved, which has been described in these columns in an article by Mr. A. F. Collins, which appeared in the issue of Nov. 9, 1901. This paper was read before the conference of the General Electric Company, on Dec. 1, 1900.

"The Latest Improvements in the Art of Spark-Telegraphy" is the title of the last paper of Dr. Slaby, which was read before the general assembly of the German Engineering Association, at Kiel, June, 1901. The subject matter of this paper deals largely with the author's improvements in the practical application of his wave theory. The papers in book form make a convenient reference of Dr. Slaby's work, which is invaluable to the technician who would have at his finger ends the complete writings of each master.

THE ARITHMETIC OF ELECTRICAL MEASUREMENTS. By W. R. P. Hobbs, R. N. Revised to date by Dr. Richard Wormell, M. A. Ninth Edition. London: Thomas Murby. New York: D. Van Nostrand Company. 112 pages, illustrated. Price, 50 cents.

The main thing of interest about this volume is the fact that it has managed to run through nine editions. Less than a dozen pages are devoted to specific statements, and in them are simply set forth the rules for calculating the resistance of parallel circuits, the strength of current with batteries grouped in various ways and how cells may be most advantageously combined to work on a given circuit. Each one of these is followed by a few examples and the entire remainder of the book by problems to be worked out by the reader, the answer of each being given.

PHYSICAL DETERMINATIONS. Laboratory Instruction for the Determination of Physical Quantities. By W. R. Kelsey, B. Sc., A. I. E. E. London: Edward Arnold. 316 pages, illustrated. Price, 4 shillings and sixpence.

This is one of the large family of text-books intended for student's use as a laboratory manual and guide. In reviewing works of this character it is always interesting to note the particular trend of the various authors' fancy, some of them making a specialty of one branch of physics and some of others. In the present case electricity and magnetism seem to be the hobby; a full one hundred pages are devoted to it, light coming next with about fifty, heat with about the same, and sound last of all, with less than twenty.

It is to be regretted that there are so few illustrations. In a great many instances it is necessary to wade through a page or two of description of apparatus which could be understood at a glance if a line drawing had been provided, and even then the reader is left with a far less clear conception of details. There are a few cases in which the description is absolutely unintelligible, and while this may not be of very great importance where the volume is used as a text book in a laboratory where the actual apparatus is at hand, it certainly greatly diminishes the value of the book as a work of reference.

Viewing it in the light of a text-book pure and simple, the omission of important preliminary instructions, such as the necessity of systematic working and tabulation of results and the liberal use of curves is open to unfavorable criticism. To indicate the habit of systematically recording the results of observations in a clear and concise manner is one of the most important functions of the instructor and his right-hand assistant—the text-book, and failure to lay emphasis on such fundamental requirement is a conspicuous fault.

Another point which we would criticize unfavorably is the entire omission of definitions of units. As a beginner frequently requires to refer to such data, they should be readily accessible. Under the electrical section no space is devoted to the derivation of standards, and in a book on physical determinations this would certainly seem to be a proper starting point.

In the hands of an instructor ready to point out and supply omissions, the book will, however, undoubtedly be of much value, as the tests are arranged in a logical and systematic manner and go to the heart of the questions with great directness. The book will also be found convenient by those who are already conversant with the general subjects treated, but whose knowledge has become rusty through lack of use and requires a quick polishing up when a problem in measurement is presented for prompt solution.

L'ANNÉE ELECTRIQUE, Electrotherapique et Radiographique, 1901. By Dr. Foveau de Courmelles. Paris: Ch. Beranger. 404 pages. Price, 3.50 francs.

This annual review is mainly devoted to the progress of electrotherapy and radiography with Röntgen rays. About one-third of the book is occupied with these subjects. The remainder deals with brief accounts of progress made during 1901 in electrical science, electrochemistry, electric lighting, heating, telegraphy, telephony, wireless telegraphy, electric traction, electricity in warfare, and diverse applications. The book is well prepared and valuable as a reference in the therapeutic and radiographic departments. It necessarily gives only a cursory view of the progress made in the other fields of electric application. Considering, however, the breadth of the whole series of subjects, the representation made is excellent, and the best that we have seen in the French language. In fact it would be difficult to find a book in any language that attempts so earnestly to display the progress that has been made during any year in the electric arts and sciences. Electric transmission of power and dynamo-electric machinery have received the briefest consideration. The book is most suitable for electrotherapeutists who also take an interest in electric applications generally.

BOOKS RECEIVED.

NATURLEHRE. By Dr. Alois Lanner. Wein: Jos. Roth'schen Verlagsbuchhandlung. 377 pages, 377 illustrations.

DIE TELEGRAPHIE OHNE DRAHT. By Adolf Prasch. Wien: A. Hartleben. 272 pages, 202 illustrations. Price, 5 marks.

ELEMENTARE VOLESUNGEN UBER TELEGRAPHIE UND TELEPHONIE. By Dr. Richard Heilbrun. Berlin: Georg Siemens. 64 pages, 44 illustrations. Price, 1.60 marks.

ANLASSER UND REGLER FUR ELEKTRISCHE MOTORMEN UND GENERATOREN. By Rudolf Krause. Berlin: Julius Springer. 92 pages, 97 illustrations. Price, 4 marks.

HANDBOOK OF ELECTRICAL MACHINERY AND APPARATUS. By Geo. L. Anderson, A. M. New York: D. Van Nostrand Company. 161 pages, 214 illustrations. Price, $3.00.

DIAGRAMS OF MEAN VELOCITY OF UNIFORM MOTION OF WATER IN OPEN CHANNELS. By Irving P. Church. New York: John Wiley & Sons. 11 Diagrams. Price, $1.50.

THE MUNICIPAL YEAR BOOK, 1902. With Summaries and Editorial Discussion. Edited by M. N. Baker, Ph. B. New York: The Engineering News Publishing Company. 310 pages. Price, $3.00.

THE ELECTRICAL CATECHISM. 533 Plain Answers to 533 Practical Questions About Electrical Apparatus. Compiled from the Regular Issues of *Power*. New York: Hill Publishing Company. 210 pages, 246 illustrations. Price, $2.00.

Power Development in Southern California.

The fact that the Edison Electric Company, of Los Angeles, has placed bonds during the last few days in New York to the amount of $10,000,000, of which $3,000,000 is to be immediately available, indicates the process by which the supply of electric energy will be provided for the roads yet to be built in Southern California. John B. Miller, treasurer of the Edison Company, has just returned to Los Angeles from New York, where he placed the bonds on the basis of all the money being available during the next five years, as required. With the funds thus made available, the company proposes to increase its capacity to 25,000 horse-power. The enlargement includes the building of a steam plant and of the plant for utilizing the power of Kern River. Work on the water power plant is well in hand, and ground has been broken on a four-acre tract in Los Angeles for the steam plant.

Mr. Miller has made the following statement of the plans of the company: "The $10,000,000 of the Edison Electric Company's bonds were taken by a banking syndicate consisting of N. W. Harris & Co., of Chicago; E. H. Rollins & Sons, of Boston, and Perry Coffin & Burr, of Boston. The company's plans include not only the building of a new steam plant and the enlargement of its present water-power plant, but also the extension and improvement of the system in every direction.

"The detail thus far decided upon for the enlargement of the latter plant are as follows. There will be 840 feet effective head, diverting dam, a canal consisting mainly of tunnels in solid rock, with water capacity of not less than 300 cubic feet per second; hydraulic and electric machinery in a fire-proof power house, with a standard rated capacity for delivering 20,000 hp to the transmission lines; two pole lines, and at least two transmission circuits, having at least three wires each, and having a total capacity for delivering at Los Angeles 16,000 hp at 10 per cent., line loss, and 9 per cent, power factor, at 40,000 volts (although without doubt the voltage to be used will be 60,000 or 65,000); and a receiving installation for 18,000 hp at Los Angeles, with all accessories, such as switchboard, transformers and lightning arresters.

"As to the new steam plant, it is our intention to design a modern one, for supplying current to our entire system, to work in conjunction and in parallel with our several water-power plants. We shall incorporate in this plant the highest degree of engineering practice, with its consequent economy of operation. The plant is to have an ultimate capacity of 5,000 kw, divided into four or five units of 1,250 or 1,000-kw capacity each. Two thousand kw will be installed as soon as deliveries can be had. The generators are to be connected direct to compound-condensing engines, or possibly to steam turbines, using superheated steam. The boilers will be of the high-pressure, water-tube type, with a total capacity of about 8,000 hp, divided into units of 500 hp each.

"In connection with the boilers will be installed economizers and superheaters. We probably shall use a self-sustaining steel stack, brick lined. We shall use surface condensers, which, in addition to the economy added to the engines, will increase the economy and life of the boilers by insuring a good feed of water and absence of scale-forming properties. We shall, of course, design the plant to use oil as fuel.

The whole mechanical and electrical equipment will be designed with a view to simplicity of operation, low cost of maintenance, and symmetry of arrangement. It will be laid out in such a way that complete, simple and easy provisions will obtain for future extensions and increase of capacity. A large overhead traveling crane will be installed in the engine room to facilitate prompt handling of apparatus, especially in case of emergency or the making of repairs."

Mr. Miller added that at present the company's Los Angeles plant has a capacity of 8,000 hp, and there is being completed a 3,000 hp plant at Redlands. With the building and equipping of the new steam plant, which will require seven months, the Edison company will have at its disposal 20,000 hp by water-power generation, and 6,000 hp by steam generation as a reserve. "There is a market," said Mr. Miller, "for all the electricity we can generate. In addition to street railway consumption, there is demand for fully 12,000 hp of electrical energy along our line, taking in Santa Ana, Los Angeles and Redlands."

Wireless Telegraphy from Hawaii to San Francisco.

It is reported that Mr. John D. Spreckels, who is so very largely interested in Hawaiian industries, contemplates establishing a wireless telegraph system between the islands and San Francisco. This project, however, is dependent upon the success of the system being installed between Los Angeles and Catalina Island, 40 miles off the coast.

System for Calling Carriages by Electricity.

One of the greatest drawbacks and nuisances of city life after dark is the trouble caused in getting carriages to the door of a theatre, opera house, reception, etc., after the affair is over. Various schemes have been tried, but until quite recently, at least so far as New York is concerned, one's carriage is brought out of chaos by means of stentorian shouting. The clamor and confusion are immense; foot passengers are seriously incommoded by the absence of system, while people living in adjacent streets and nearby houses have life made a burden each night for an hour or two just when they would be asleep.

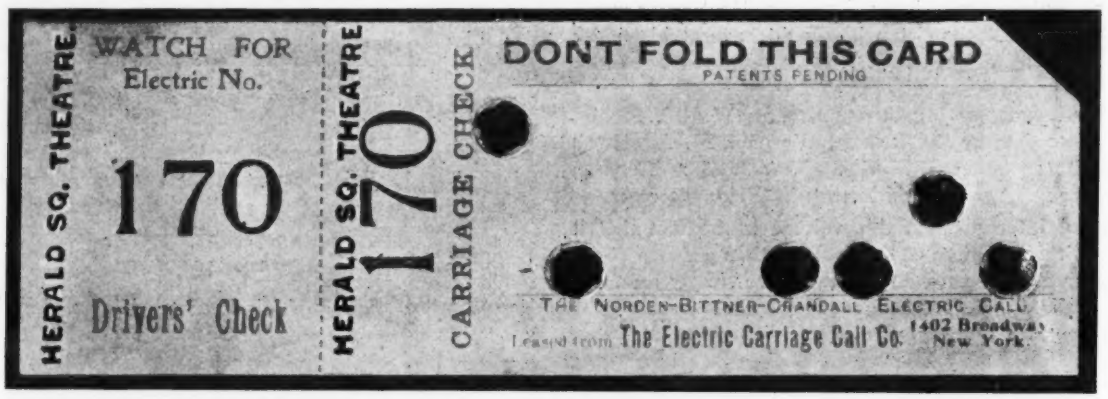


Fig. 1.—Carriage Ticket.

It would appear that the electrical carriage call system here illustrated is a most ingenious and laudable effort to contend with the difficulties of the problem, while reports of its use go to show that the apparatus is a decided success. This system, which is the invention of Messrs. Mortimer Norden and Lucien S. Crandall, is being introduced by the Electric Carriage Call Company, of 1402 Broadway, New York, and operates in the manner which will now be described.

The system depends broadly upon the use of a perforated ticket, which tears in two, and of which the perforated end is retained by the carriage occupant, while the driver gets the other end, numbered. This card is shown in Fig. 1. When the performance is over, and the carriage is needed, the perforated end is given up by its holder and is inserted in a box or switch, which immediately flashes the number required on a large lamp sign over the street, to be seen by the driver. The cards are made of heavy manila, like postal card stock, and as the tear-off coupon is numbered the same as the

perforated section, the perforations correspond to the number just as the holes in a pianola roll enable corresponding bars of

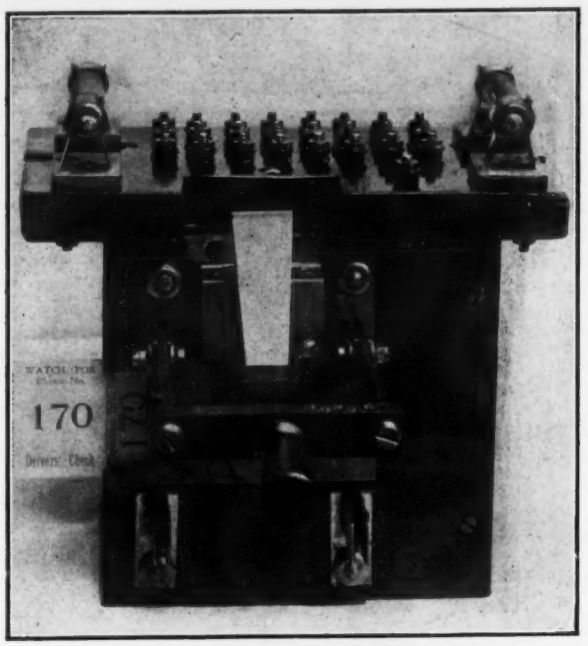


FIG. 2.—TICKET SWITCH.

music to be played, it is not possible to call up the wrong carriage.

Fig. 2 shows the switch into which the card is inserted when given up by the person holding it. This switch is of standard form, fitted with special plate and pin contacts, enabling the proper circuit connections to be made through the holes in the card to the lamps in the street sign. The plate containing the spring pins is first forced down to the proper contacts by throwing the switch, as indicated in the cut. When the switch is released, it opens the circuit arcing only at the clip contacts and not at the contact pins, thereby preventing any oxidation of the pin contacts. The side where the card is inseerted is slotted so that the card cannot slip or drop out, but can also only be inserted in the proper way.

From the lower contact terminals the circuit wires are run to a small slate distributing board on top of the switch, and thence by cable to the sign board. The mains first connect to the fuses of the enclosed type, and thence to the lower coils.

Fig. 3 is a detail of the "number," showing the tube in which each lamp is placed, preventing the light from radiating in any but the desired direction and also avoiding exposure to the weather. The "number" is made in the sizes from 14 inches high and 12 inches wide to 5 feet high and 4 feet wide. It can be read as easily in the day as at night, and is shown built up into a panel complete in Fig. 4, which is of galvanized iron, wired to meet the requirements of the underwriters.

One of the first installations of the system was at the Criterion Theatre, Forty-fourth street and Broadway, New York City; and another is at the Herald Square Theatre, of the type shown in Fig. 4. The management of the latter place state that carriages can be called ten minutes quicker than before, and that it is even possible with one switch and sign to call up 10 to 15 carriages per minute. Since the installation at the Herald Square and Criterion

FIG. 3.—ARRANGEMENT OF LAMPS.

Theatres the company have closed contracts with the Metropolitan Opera House for three, one in Buffalo, two in Kansas City, two in San Francisco, three in Boston, three in Philadelphia, and are now negotiating with numerous electrical firms for State rights. They do not sell the machine outright, but rent at low monthly rates.

The device can be used for private gatherings, such as balls, parties, and other social functions, as they are entirely portable and can be installed in a few minutes. The current required for a single-sided sign is about 4 amperes, and the cost of operating one night will not exceed 15 or 20 cents. The size lamps used are 4 c. p. Any number of sign boards can be operated from the one switch.

The company have one machine in operation in London for the coronation, and are installing one in Paris. The system can also be used to call members of the stock exchange, or waiters in large restaurants, notifying them when their order is ready in the kitchen, so that they are on duty at tables continually until wanted in the kitchen. Three of these are now being installed at the Terrace Garden, New York, for that purpose.

FIG. 4.—CALLING BOARD.

Constant Alternating Current Transformer Panels.

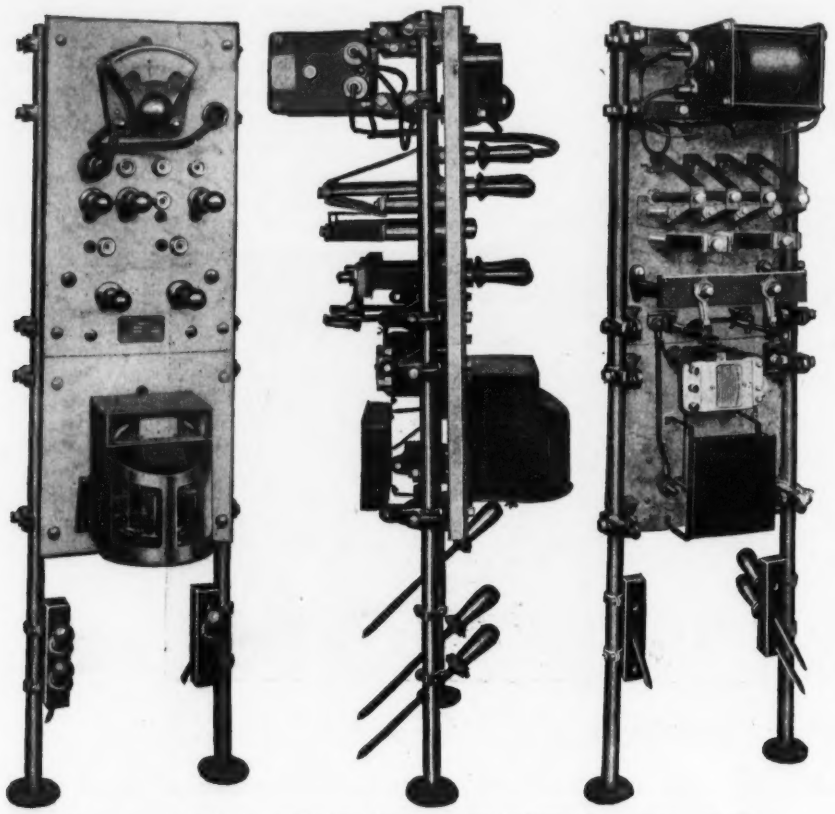
The General Electric Company has designed a line of panels for use in connection with the Thomson alternating constant-current series arc-lighting system, which system employs, as will be recalled, a special type of transformer which, by means of movable coils, maintains constant the current supplying a series arc circuit. The panels are designed for installation immediately beside the transformer controlled, and, therefore do not form part of the usual station switchboard.

The panel, which is shown in the accompanying illustration, consists of a single piece of blue Vermont marble, 28 inches in height and 16 or 20 inches wide. This panel is supported 36 inches from the floor, and a standard sub-base of similar width and 16 inches in height, equipped with a recording wattmeter for the measurement of

the total input of energy to the transformer, can also be attached. The panel is equipped with the following devices:

Ammeter; current transformer (on all panels for 35 lamps and above, but not on smaller panels); ammeter connection plug with necessary cable (on all panels for 50 lamps and above, but not on smaller panels); ammeter plug receptacles (one for each side of each circuit controlled by the panel, for 50 lamps and above, but not on smaller panels); open circuiting plugs and receptacles (two for each circuit controlled); short-circuiting plugs and receptacles (one for each circuit controlled); two primary switch plugs and receptacles; two plug racks for the reception of all idle plugs; two primary fuses.

The General Electric standard form of primary plug switch and the standard form of tubular expulsion fuse have been combined in a single element for more convenient application to constant transformer panels. The plug switch will open the circuit to which it is applied, under any condition of load. The fuse used is of such a capacity as to rupture only under emergency conditions equivalent to a short circuit in the transformer. The only difference existing between the standard panels for 1,100 and 2,200 volts is in the capacity of the fuse. The short-circuiting plugs and receptacles consist of a simple plug switch, one for each secondary circuit, and are used to short-circuit the lamp circuit in starting up the transformer, provided the transformer is started from the switchboard. These plugs are used also on a double-circuit transformer, in case one circuit only is to be operated. One plug and receptacle is provided for



FIGS. 1, 2 AND 3.—CONSTANT-CURRENT TRANSFORMER PANEL, WITH WATTMETER ATTACHMENT.

opening each side of each circuit. In connection with the short-circuiting plug, these plugs serve to disconnect any circuit from the transformer. Work may be easily and safely done upon a circuit so disconnected without shutting down the transformer. These plugs and receptacles are furnished with all constant-current transformer panels.

The General Electric standard form of arc circuit ammeter is used on these panels, the scale being so marked as to render the ammeter interchangeable for 6.6 and 7.5 ampere circuits. A single ammeter is used for each panel. This ammeter is connected through a double-conductor cable with a two-part plug, which, when inserted in any one of the ammeter connection receptacles, throws the ammeter in series with the outgoing or incoming leads of either circuit. The purpose of providing a receptacle for both the outgoing and incoming sides of each circuit is to facilitate testing for grounds. Any leakage or flow of current to ground will show a difference of reading when the ammeter is plugged into different sides of the circuits. The use of the ammeter connection plug provides for the measurement of the current of either circuit with only one ammeter. Ammeter transformers are provided for panels controlling more than 25 lights. A plug rack provides a permanent receptacle for all plugs not in use.

Desk Telephones.

It begins to be a question whether as many telephones are not now to be found on desks as are applied to the wall; for no modern city desk seems complete without its means of communication with the outside world. This may serve to explain the rapid improvement made in desk telephones, as exemplified

FIG. 1.—CAST-BASE DESK TELEPHONE.

FIG. 2.—COMPOSITION-BASE DESK TELEPHONE.

in the two sets here shown in Figs. 1 and 2, apparatus produced by the Russell-Tomlinson Electric Company, of Danbury, Conn. Fig. 1 shows a set with a heavy cast base, ornamented, in which all the connections are made, so that there are no outside connection contacts. It is finished in full nickel. Fig. 2 illustrates a similar form, made up with composition metal base, highly finished and heavily nickel-plated.

NEWS OF THE WEEK.

Financial Intelligence.

THE WEEK IN WALL STREET.—The past week was an active one on the stock exchanges, and there were some remarkable advances. The market was, however, no less dangerous than it was buoyant, for it was difficult to see where manipulations ended, and equally hard to see the reason for some fluctuations. Possibly the strength of the railroad situation, the better aspect of the crops, and the steady activity in the industrial world were enough to explain all, but no one in Wall Street doubts that the hand of the expert was at work. In the electrical and traction group prices were a bit off, except Westinghouse Electric, the preferred of which rose from 213 to 218, and the common from 208 to 210. On sales of 75,800 shares, Brooklyn Rapid Transit went off from 72⅜ to 69¼; Metropolitan Street Railway, on 20,400, from 152½ to 150, and Manhattan Elevated from 136¼ to 134¾; General Electric also was off on 5,000 shares from 190½ to 187½. Western Union, also, after a boom slid back to 86¼, showing a net decline of 2⅛. The "outside market" was generally inactive, and no changes of any note occurred during the week. Below are given the latest prices for July 29 and approximate dates, furnishing latest quotations:

NEW YORK.

	July 22.	July 29.		July 22.	July 29.
American Tel. & Cable..	—	—	Hudson River Tel.....	—	—
American Tel. & Tel..	—	164	Metropolitan St. Ry...	150¾	149⅜
American Dist. Tel....	—	—	N. E. Elec. Veh. Trns..	—	—
Brooklyn Rapid Transit.	71¼	68¼	N. Y. & N. J. Tel....	—	—
Commercial Cable	—	—	N. Y. E. V. T. Co....	—	—
Electric Boat	30	30	Tel. & Tel. Co. Am....	—	—
Electric Boat pfd.....	50	50	Western Union Tel....	88½	86⅛
Electric Lead Reduc'n..	3	—	West. E. & M. Co.....	205	—
Electric Vehicle	6	7	West. E. M. Co. pfd..	213	210½
Electric Vehicle pfd....	14	—			
General Electric	188½	184½			

BOSTON.

	July 22.	July 29.		July 22.	July 29.
American Tel. & Tel..	—	164	Mexican Telephone	2⅜	—
Cumberland Telephone .	—	125	New Eng. Telephone....	142½	144
Edison Elec. Illum....	—	280	Westinghouse Elec.	—	—
Erie Telephone	—	—	Westinghouse Elec. pfd	—	—
Western Tel. & Tel....	29	—			
Western Tel. & Tel. pfd.	102½	—			

PHILADELPHIA.

	July 22.	July 29.		July 22.	July 29.
American Railways	46½	47	Phila. Traction	99⅞	99⅞
Elec. Storage Battery .	93	92	Phila. Electric.....	5⅜	5 9/16
Elec. Storage Bat'y pfd.	—	—	Pa. Elec. Vehicle.....	—	—
Elec. Co. of America..	8¼	8⅞	Pa. Elec. Vehicle pfd..	—	—

CHICAGO.

	July 22.	July 29.		July 22.	July 29.
Central Union Tel.....	—	—	National Carbon pfd.....	101	107½
Chicago Edison	180	177	Northwest Elev. com...	35⅜	37
Chicago City Ry.....	210	220	Union Traction	16⅝	15¼
Chicago Tel. Co.....	—	127¼	Union Traction pfd....	—	—
National Carbon	29	—			

* Asked.

PRICE OF GENERAL ELECTRIC.—When the stock rights on General Electric were announced, there was speculation as to the probable price of the stock ex-rights. Some very well informed people, says the *Wall Street Journal*, thought the stock would not sell higher than 160. Insiders believed that it might reach 180. All have been surprised by the result of the company's business thus far this year. Sales for the four months ended May 31, amounted to $10,175,379. The cost of manufacturing and selling was $7,891,707, leaving a profit of $2,283,672. Profits on sales of securities of other companies, royalties, interest and dividends, with some miscellaneous profits brought in $510,254 against which the company paid $10,099 interest on debentures, and $499,906 in dividends, leaving the net profit for four months $2,283,921, or almost 5½ per cent. on the present volume of stock, $42,031,600. This is at the rate of over 21 per cent. per annum, and while, prehaps, it is unreasonable to believe that so large profits can be maintained, it is fair to assume that profits will be fully double the present dividend requirements. Furthermore the company has a surplus of $17,571,061 from which to draw.

INVESTMENT IN JAPAN.—New Yorkers, who are represented in Japan by A. Tsion, formerly of the Japanese Imperial University, have purchased control of the gas companies of Osaka and Tokio, which are earning large profits. Both companies needed large funds for extension. The Tokio company has a paid-up capital of 4,200,000 yen in shares of 50 yen each, which are selling at above 70 yen. The arrangement made with the New York capitalists is to double the number of shares, the Americans buying the increased stock at 80 yen per share. A sum representing the premium on shares is set aside for reserve, and the balance will be devoted to extensions. An arrangement recently made with Osaka is of a similar nature. The preliminary arrangements are said to have been made in New York by Baron Shibusawa.

DIVIDENDS.—Twin City Rapid Transit has declared the regular quarterly dividend of 1¼ per cent. on the common stock, payable August 15. The Allis-Chalmers Company has declared fifth consecutive quarterly dividends of 1¾ per cent. on its preferred and common, out of net earnings, payable August 1. The American Light and Traction Company has declared a quarterly dividend of 1½ per cent. on the preferred stock, payable August 1. The New England Telephone and Telegraph Company has declared a dividend of $1.50 per share, payable August 15. The Westinghouse Electric and Manufacturing Company has declared a dividend of 1¾ per cent. on its assenting stock, payable August 15.

BOSTON ELEVATED.—A special meeting of the stockholders of the Boston Elevated Railway was held last week, to authorize an increase in the capital stock from $10,000,000 to $15,000,000. Boston Elevated people explain the proposed issue of $5,000,000 new stock by the following statement: "The cost of erection of the Elevated structure, both road and terminals, has far exceeded the estimates of our engineers. The cost of our rolling stock also exceeded original estimates, and the new stock issue is to pay the indebtedness thus incurred and also for the purpose of meeting land and other damages. No part of this new issue will be used for extension, such as extending the road to Cambridge."

GERMAN ELECTRICAL SECURITIES.—A cable dispatch from Berlin, of July 27, says: The annual balance sheet of the Schuckert Electrical Company, of Nuremberg, published last evening, shows a loss of 15,200,000 marks, against net earnings of 6,250,000 marks for the preceding year, which amount was carried forward to the new account, and is now lost. The report of the Continental Company for electrical undertakings, which concern the Schuckerts are financing, shows a loss of 1,198,372 marks, and the Schuckerts had to write off 9,000,000 marks to cover the depreciation of the securities they held.

CLEVELAND TELEPHONE BONDS.—Holders of the 5 per cent. bonds of the United States Telephone Company have signed an agreement not to sell these bonds for less than 90 before July 1, 1903. According to this agreement, H. A. Everett, J. R. Nutt and others are appointed a sales committee with power to negotiate for the sale of these bonds for 90 or better. The Federal Telephone Company owns between $600,000 and $700,000 of these bonds, and if they could be sold the Federal situation would be greatly relieved. The earnings of the United States Company are making rapid gains.

PERUVIAN TROLLEYS.—The Lima Street Railway Company has incorporated under the laws of New Jersey, with a capital stock of $5,000,000, divided into $1,000,000 preferred stock bearing 7 per cent. cumulative dividends, and $4,000,000 of common stock. The charter sets forth that the company will operate street railways in Lima. Callao, Miraflores, Barranco, Charilles, and other cities in Peru. The incorporators are Charles A Neville, Henry W. Carter, and Charles Bath, presumably New Yorkers.

SPRAGUE GENERAL ELECTRIC DEAL.—The terms offered by the General Electric Company to holders of Sprague Electric Company securities, having been accepted by holders of 74 per cent. of the capital stock and 88 per cent of the bonds, President Markle, of the Sprague Company, declares that the sale of the company to the General Electric Company has become operative. The General Electric Company has deposited the cash necessary to carry out the contract with the United States Mortgage and Trust Company, New York.

MICHIGAN TELEPHONE CO. BONDS.—A large majority of the consolidated mortgage 5 per cent. bonds of the Michigan Telephone Company having been deposited with the Old Colony Trust Company of Boston, as depository under the bondholders' agreement, dated June 28, the time for the deposit of bonds has been extended until August 5, after which no deposits will be received, except upon such terms as the committee may prescribe.

CONNECTICUT CONSOLIDATION.—The United Gas Improvement Company, of Philadelphia, is reported to be negotiating for the Hartford, Conn., Street Railway Company, the Hartford Electric Light Company and the Fair Haven and Westville Street Railway at New Haven, Conn.

Commercial Intelligence.

THE WEEK IN TRADE.—Commercial and industrial reports for the midsummer climax of vacation and dulness are remarkably good. Crop statements are excellent, especially from the southwest and northwest, and all the railroads are well employed in the agricultural regions, with only a little off-setting complaint as to the check imposed on pleasure travel by the continued cold and wet weather. An active distribution of merchandise is going on, and railway earnings thus far as reported for July are 2.5 per cent. in excess of 1901 and 20 per cent. better than in 1900. The short supply of fuel is a check on the iron and steel trade, and there is a keen inquiry for pig iron, steel rails and structural steel. *Bradstreet's* reports 178 failures in the United States during the week, against 174 for the previous week, and 199, 183, 170 and 189 for the corresponding weeks of 1901 to 1898. The Middle States had 55; New England, 28; Southern, 26; Western, 38; Northwestern, 17; Pacific, 10, and Territories, 4. Canada had 16, against 17 for the preceding week. About 91 per cent. of the total number of concerns failing had capital of $5,000 or less, and 7 per cent. had from $5,000 to $20,000 capital.

EXPORTS OF ELECTRICAL MATERIALS.—The following are the exports of electrical materials from the port of New York for the week ended July 9: Antwerp—3 pkgs. machinery, $257; 7 pkgs. material, $2,264. Argentine Republic—82 pkgs. material, $1,547; 5 pkgs. machinery, $466. British East Indies—170 pkgs. material, $6,163; 5 pkgs. machinery, $562. British West Indies—26 pkgs. material, $655; 22 pkgs. machinery, $1,500. Bremen—14 pkgs. material, $170; 2 pkgs. machinery, $87. Brazil—13 pkgs. material, $7'9; 86 pkgs. machinery, $5,825. Barcelona—6 pkgs. machinery, $439; 7 pkgs. material, $212. Berlin—38 pkgs. material, $646. Brussels—4 pkgs. material, $200. British Guiana—9 pkgs. material, $440. British Possession in Africa—2 pkgs. material, $260; 120 pkgs. material, $6,899. British Australia—22 pkgs. material, $960. Cuba—60 pkgs. material, $1,355. Central America—36 pkgs. material, $424. Chili—32 pkgs. material, $12. Dutch Guiana—1 pkg. material, $12. Dutch West Indies—5 pkgs. material, $26. Frankfort—3 pkgs. material, $113. Genoa—2 pkgs. machinery, $75. Glasgow—3 pkgs. material, $413; 5 pkgs. machinery, $1,743. Grenoble—3 pkgs. material, $455. Havre—17 pkgs. machinery, $444; 21 pkgs. material, $906. Hamburg—5 pkgs. machinery, $632; 68 pkgs. material, $4,204. Liverpool—32 pkgs. material, $1,288. Leeds—12 pkgs. material, $141. London—207 pkgs. machinery, $5,649; 133 pkgs. material, $6,148. Moscow—7 pkgs. machinery, $320. Mexico—27 pkgs. material, $599; 1 pkg. machinery, 129. Manchester—17 pkgs. machinery, $9,680; 3 pkgs. material, $390. Odessa—5 pkgs. material, $130. Peru—51 pkgs. machinery, $1,978. Rotterdam—2 pkgs. machinery, $485; 1 pkg. material, $50. St. Petersburg—2 pkgs. material, $200. Southampton—23 pkgs. material, $1,519. U. S. Columbia—22 pkgs. material, $996. Venezuela—171 pkgs. material, $1,475. The following are the exports of electrical materials and machinery from the port of New York for the week ended July 26: Argentine Republic—42 pkgs. material, $1,364. Antwerp—18 pkgs. machinery, $833. Azores—4 pkgs. material, $188. Berlin—20 pkgs. material, $500. British West Indies—19 pkgs. material, $488; 25 pkgs. machinery, $860; British East Indies—7 pkgs. material, $303; 1 pkg. machinery, $10. British Possessions in Africa—15 pkgs. machinery, $1,649; 123 pkgs. material $5,714. Brazil—84 pkgs. material, $4,813; 48 pkgs. machinery, $2,095. British Australia—23 pkgs. machinery, $1,792; 148 pkgs. material, $11,814. Christiana—2 pkgs. machinery, $483. Cuba—8 pkgs. machinery, $121; 32 pkgs. material, $900. Copenhagen—8 pkgs. machinery, $332; 3 pkgs. material, $93. China—7 pkgs. machinery, $199. Chili—7 pkgs. material, $142. Central America—19 pkgs. material, $367. Ecuador—3 pkgs. material, $25. Genoa—4 pkgs. material, $200. Glasgow—4 pkgs. material, $405; 49 pkgs. machinery, $1,417. Helsingfors—1 pkg. material, $10. Hong Kong—5 pkgs. machinery, $200. Hamburg—1 pkg. machinery, $65. Havre—41 pkgs. machinery, $1,184; 24 pkgs. material, $1,160. Japan—73 pkgs. material, $6,799. London—196 pkgs. material, $10,717; 16 pkgs. machinery, $591. Leeds—2 pkgs. machinery, $122. Lisbon—12 pkgs. material, $402. Liverpool—74 pkgs. machinery, $8,279; 38 pkgs. material, $1,493. Mexico—12 pkgs. material, $121; 14 pkgs. machinery, 977. Manchester—6 pkgs. machinery, $1,359. Nova Scotia—15 pkgs. material, $108. New Castle—3 pkgs. material, $417. Naples—1 pkg. material, $50. Portsmouth—1 pkg. material, $76. St. Petersburg—3 pkgs. machinery, $190. Sheffield—3 pkgs. machinery, $1,876. Stockholm—1 pkg. machinery, $104. U. S. Colombia—42 pkgs. material, $374. Venezuela—18 pkgs. material, $737.

THE PELTON WATER WHEEL CO., of San Francisco and New York, reports an unusually large number of orders lately, both foreign and domestic. Among those received by the San Francisco branch might be mentioned: Three units, aggregating 3,200 hp, for the Bay Counties Power Company; two units for driving generators, for the Yosemite Valley (National Park) plant; 2,000 hp plant for Clark Electric Company, Ophir, Utah; wheels for operating plant of the Pacific Portland Cement Co., of Spokane, Wash.; one 500 hp wheel for the Lewiston Water & Power Co., of Lewiston, Ida.; one 800 hp wheel for the United Light & Power Co., Georgetown, Colo. Also complete plants for Hilo Electric Light & Power Co., Hilo, H. T.; Cia. de Transmission Electrica de Potencia; Oroville Gas & Electric Co., Ouray Electric Light & Power Co., Ouray, Colo.; Bagnall & Hilles, Japan; Cariboo Gold Fields, Barkerville, B. C.; Ardjasarie Electric Power & Transmission Co., Batavia, Java; Sullivan Group Mining Co., Marysville, B. C.; and wheels for operating the entire mine and milling machinery of the Eagle Shawmut Mining Co., Chinese, Cal. Among the most recent foreign orders received from their New Yok office might be mentioned: A 2,000 hp water-wheel plant and three miles (1,500 tons) of large diameter steel pipe, for a large cement factory near Barcelona, Spain; a 250 hp unit and 2,000 feet of 24-inch steel pipe for the San Juan Cotton Mills, of Puebla, Mexico; two 250 hp wheels for driving electrical apparatus in France; a 200 hp unit for the same purpose at Bologna, Italy; besides several smaller plants to be used on sugar plantations in the West Indies.

LARGE SAN FRANCISCO CONTRACTS.—The United Railroads of San Francisco has closed an important contract with the General Electric Company for further equipment. The second plant now ordered will consist of two 1,250-kw General Electric 3-phase generators, direct connected to one Union Iron Works 4,000-hp triple expansion engine. There will be two 800-kw rotary transformers, with switchboards and auxiliary apparatus. It will be a 25-cycle plant. Delivery should be made in about seven months. The first unit, which was ordered some months ago, will probably be installed and in operation late in the present year. All of this apparatus will be placed in the new power station now in course of construction, on Jefferson street, near the Bay shore. The building will have space enough for the installation of a 16,000-hp plant, the largest on the Coast. The first and second contracts cover about half of the total capacity of the plant. The second boiler contract has been let through Chas. C. Moore & Co., of San Francisco. It calls for 8 Babcock & Wilcox water-tube boilers, having a capacity of 550-hp each. All of the pressure parts are of forged steel for 200 pounds pressure. Green's fuel economizers are included. There will be two steel-plate, induced draft fans, each having sufficient capacity for half of the 16,000 hp. These fans will be held in reserve in case it should ever become necessary to burn coal. C. C. Moore & Co. will install the boiler plant and the oil burning system. The National Supply Company's apparatus will be used.

MINE VENTILATION CONTRACT.—Among the recent contracts awarded to the Buffalo Forge Company, of Buffalo, N. Y., is one of particular interest, that of the Continental Coal Company, of Glouster, Ohio, who have ordered three 250-inch fans installed in their mines for the purpose of ventilating and exhausting fumes, smoke and dangerous mine gases. The fans are 250 inches, housing of ¾ type, and of the special width of 72 inches. The sides are built of extra heavy steel plate and are thoroughly braced with angle irons of ample size, effectually preventing all vibration. The blast wheels of these fans are of the usual centrifugal type. The radial blades or vanes with backwardly curved tips are supported by two spiders of wrought iron tees springing from cast-iron hubs, and are further stiffened by the conical side plates. The fan shaft is supported independent of the housings by two standard Buffalo self-aligning, chain-oiling outboard bearings mounted on masonry pedestals. This plant is similar in many respects to that of the Modoc Coal Mining Company, located at the same place, and recently installed by this company.

TUNNEL BID ACCEPTED.—A short time ago the Rapid Transit Commission of New York opened bids for the construction of a tunnel from near the City Hall, New York, to the Battery and under the East River to Brooklyn, constituting an extension of the subway now being built in Manhattan. The Rapid Transit Construction Company, headed by August Belmont and John B. McDonald, presented two propositions. The first offered to build the tunnel for $2,000,000, or with all terminals for $3,000,000. The second bid proposed to construct the tunnel for $4,000,000, and, if this bid should be accepted, they offer to construct for the nominal sum of $100,000 a subway under Broadway from Union Square to Forty-second Street. The Rapid Transit Company, of Brooklyn, bid $8,000,000. The Belmont bid has now been accepted. The Rapid Transit Construction Company now have the contract for the present subway work, and the new work will form an extension to that system. This company will control the present subway for 50 years and the extension for 35 years.

WIRELESS TELEGRAPH CONTRACTS.—The De Forest Wireless Telegraph Company announces that it has received a contract from the War Department, at Washington, for installations for four complete wireless telegraph stations. The contract calls for kerosene or gasoline motors for generating current of one horse-power capacity. The date of delivery is specified as August 15, in time for the army and navy manœuvres. The Postal-Telegraph Cable Company has arranged with the Marconi Wireless Telegraph Company, of America, for the exchange at Sagaponack, L. I., of messages to and from vessels equipped with the Marconi wireless apparatus, so that it is now possible for passengers to telegraph friends on shore either farewell messages or notice of arrival. The arrival of steamers may also be reported from Sagaponack several hours in advance of their being sighted at Fire Island or Sandy Hook.

TELEPHONE SYSTEM FOR VINCENNES, IND.—The Kellogg Switchboard and Supply Company has recently closed a contract with the Northern Construction Company, of Bryan, Ohio, for a common battery multiple switchboard for Vincennes, Ind., having 1,500 lines ultimate capacity, and a framework large enough for 3,000 lines. The present equipment will contain 640 lines. The switchboard will consist of two 6-panel, 3 position sections. The exposed cabinet work, including the cable turning section and movable end panels, will be of selected mahogany of a dead finish. Included in this contract are 600 standard common battery wall telephones, quarter sawed oak woodwork and concealed line binding posts; also all necessary power apparatus, main and intermediate distributing frames, relay racks and sneak current arrester equipment.

FOUR THOUSAND TWO HUNDRED HP. EQUIPMENT FOR MEXICO.—The Mexican Gas & Electric Light Company, a British capitalized concern, has let contracts for the construction and equipment of a new 4,200 hp power station, which is to be built in the city of Mexico. Milliken Brothers have been allotted the contract for the requisite structural material. The Mexican General Electric Company, which represents the General Electric Company in Mexico, has secured the contract for three 800 kw generators and one of 400 kw. The engines are to be furnished by McIntosh, Seymour & Co. There will be three cross-compound condensing engines of 1,200 hp each and one machine having a capacity of 600 hp. These engines are to be direct connected to the generators.

THE STANDARD POLE AND TIE COMPANY, of 44 Broad Street, New York, have just completed the delivery of their second large order from the Central New York Telephone and Telegraph Company, of Utica, New York. The poles which have been supplied are the Southern white cedar or juniper poles, of which the Standard Pole and Tie Company make a specialty. They began to introduce this pole in the northern market about two years ago, and now they report that the orders are coming in as fast as they can handle them. The main reasons for the extreme popularity of the juniper pole are its freedom from butt rot and its symmetry and straightness. The poles ordered by the Central New York Telephone and Telegraph Company were for use at Utica, Syracuse and vicinity.

SHANGHAI LIGHTING PLANT TO BE ENLARGED.—The electrical light plant which furnishes power for lighting the foreign settlement at Shanghai, and is operated by the municipal council of that Chinese city, is about to be considerably enlarged. The contracts will be let through Fearon, Daniel & Company, of China, whose New York offices are at 90-96 Wall street. This firm is at present making some fair-sized purchases for supplies, etc., for the plant. The General Electric Company has secured a contract for arc lamps. An order calling for some $5,000 worth of fans for office and private-house use were shipped lately to Shanghai, through Fearon, Daniel & Company, by the Federal Electric Company.

LEWISTON, IDA., ENLARGED PLANT.—The board of trustees of Lewiston, Ida., have decided to enlarge the electric light plant. The cost of the betterment now going on will aggregate some $16,000. This includes a new 500 hp Pelton wheel, a larger penstock to take water from the high flume of the Vineland Company, enlargement of the flume, new street arc lamps for Lewiston throughout, new transformers, and extensions of the company's lines. The proposed enlargement in the capacity of the plant includes a new generator, more transformers, etc., which would cost about $15,000. It is thought the company will secure the contract to furnish power to the city water works.

BIDS WANTED FOR PLANT.—Bids will be opened August 8 by Clarence M. Addison, city clerk, Columbus, O., for labor and material for the municipal lighting plant. Specifications have been prepared by Superintendent Oakley, of the electric light department, for the following: Three cross-compound (vertical or horizontal) engines of 500-hp each at 150 r. p. m.; three 400-kw steam turbines and generators; two condensers (jet or surface type); four horizontal water-tube boilers, 300-hp each, with straight tubes; one 176 x 9 self-supporting steel stack; fuel economizers; three 500-kw, two-phase, 60-cycle alternating-current generators for direct connection to engines, and fifteen hundred 7.5-ampere series, alternating, enclosed arc lamps.

POWER PLANT IN UTAH.—Construction work upon the big power plant in Beaver canyon (Utah), planned by the Majestic Co., has commenced. Bids are invited upon the construction of the lower dams, Nos. 1, 2 and 3, and upon various portions of the works. The approximate cost of these three dams will be $50,000, and they will develop 2,000 hp. Power will be delivered to the mines in the surrounding country. The company has located two additional power sites. The Cactus mine, in Copper Gulch, 50 miles away, has contracted for 500 hp upon completion of plant.

ANOTHER MEXICAN TRACTION PROJECT.—Negotiations are, according to private Mexican advices, all but completed for the electrical conversion of the existing mule line in Guadalajara, a flourishing city located on the east coast of the Southern Republic. The present system is 25 miles in length. J. M. Bermejillo, of the financial house of Bermejillo & Co., Guadalajara, holds the controlling interest in the concern. The equipment necessary for changing the road from animal to electric traction will be purchased in the United States.

AMERICAN UNION ELECTRIC COMPANY will, it is said, soon place its stock on the New York market. It has been recently organized with an authorized capital of $7,000,000, all common, of which $5,000,000 has been issued, it is said, to take over the Falcon Electric Manufacturing Company, the Electric Motor Specialty Company, the Fountain Electric Company, Union Railway Power and Electric Company, Morris Electric Company, and the Refrigerating Machine Company. The present net earnings are reported to equal 2 per cent. on the $5,000,000 outstanding.

MORE CARS FOR DURBAN, NATAL.—The British electrical engineering and contracting firm of Macartney, McElroy & Co., Havemeyer Building, has secured a further contract for cars to be shipped to South Africa, for use on an extension of the Durban municipal electric traction system. The present contract calls for 10 complete cars. Eight cars manufactured by the J. G. Brill Company, and equipped with General Electric motors, were shipped recently to the same South African road by the British concern.

PLANT FOR BURLINGTON, IA.—The People's Gas and Electric Company, successors to the Burlington Railway and Light Company, has placed the entire rebuilding of its system and power station in the hands of Royal H. Holbrook, as advisory engineer. A new engine of about 400 hp, some water-tube boilers, a condenser, about four miles of new track and a large portion of the old rebuilt and bonded, an extension of the car barns and many other improvements are contemplated. Ten new cars have been purchased from the St. Louis Car Company for September delivery.

SEARCHLIGHTS FOR THE AMAZON.—Owing to the many collisions which have recently taken place on the River Amazon, the Brazilian government has issued an order requiring all vessels plying on that water way to be equipped with search light apparatus. It is stated that between Manaos and Iquitos, a distance of 3,600 miles, fully 500 steamers are engaged in the carrying trade. Bytton Brothers, coffee exchange, New York, have received several inquiries for searchlight equipment varying from 2-kw to 7-kw sets.

BALL ENGINE ORDERS.—W. H. Wagner Sons, Freeport, Ill., are installing an electric plant, consisting of a Crocker-Wheeler generator, direct connected to an engine built by the Ball Engine Co., Erie, Pa. The United Railways & Electric Co., Baltimore., Md., are installing a 350-hp tandem compound engine, built by the Ball Engine Co.

PLANT FOR PRINCETON UNIVERSITY.—Contracts are now being let for the erection and equipment of a plant for the furnishing of light and general power at Princeton University. The contract for the boilers, which calls for four Cahall horizontal water-tube units of 300-hp each, has been secured by Thayer & Company, incorporated.

MINING PLANT ORDERED.—An order has been placed with the General Electric agent at Salt Lake, Utah., by the De La Mar Mining Co., for $30,000 worth of electrical machinery for its power plant to be built about eight miles below Calientes, Nev.

General News.

THE TELEPHONE.

OAKLAND, CALIF.—The Independent Telephone Company, which recently secured a franchise in Oakland, Calif., has made applications for franchises in Alameda and Berkley.

PASADENA, CALIF.—The Sunset Telephone Company is circulating a petition in Pasadena, Calif., against the establishing of a second telephone company in that place. The majority of the business men have signed the paper.

PASADENA, CALIF.—The Home Telephone Company is attempting to obtain a franchise in Pasadena, Calif. A petition has been circulated among the business men asking the City Council to refuse to grant a franchise to an outside company. The Pacific States Telephone Company has a system in operation and M. F. Metcalf has applied for a telephone franchise.

CANTON, ILL.—The Canton Home Telephone Company has been formed; capital, $75,000; incorporators: F. G. Bills, G. F. Miner, O. S. Baileys.

CHICAGO, ILL.—The Stephenson County Telephone Company, capital, $150,000; will operate telephone and telegraph systems. Incorporators: Fred C. Bills, George E. Miner, O. S. Baylies.

INDIANAPOLIS, IND.—The Summit Rural Telephone Company, of Henry County, has been incorporated; capital stock, $10,000.

MOUNT SUMMIT, IND.—The Mount Summit Rural Telephone has been incorporated with a capital stock of $10,000. The company will build an exchange and operate a telephone system throughout the rural districts.

VINCENNES, IND.—The Palmyra Independent Telephone Company, of Knox County, filed articles of incorporation July 17. The capital stock is placed at $14,000, but will be increased. Directors: Rob't B. Patterson, John G. Dreiman, Edward E. Shaw, J. W. Alton, V. S. Manning, L. S. Root and C. W. Wilson.

ORLEANS, IND.—The Lyria and Orleans Telephone Company, of Orange County, has been incorporated. Capital stock, $5,000. Directors: Aaron Pickens, Jas. L. Noblitt, Henry McCoy, J. R. Gifford, A. L. Gallion and Jno. M. Frost. This company will establish an exchange at Orleans, construct and operate telephone lines throughout Orange County.

BRAZIL, IND.—The new Citizens' Telephone Company are daily receiving material for the construction of their exchange and expect to have it in operation inside of ninety days. This company are composed of local capital and they will install an exclusive single party line. The switchboard has a capacity of three thousand telephones, 500 of which will be put in at once. R. H. Cokefair, an expert telephone man of Indianapolis, is superintending the putting in of the exchange.

BEDFORD, IND.—The citizens of this place are aroused and indignant over the announcement by the New Independent Telephone Company, which has secured a franchise, that the rate will be $30 a year instead of $1.25 a month, as was promised when the franchise was asked. The Central Union Telephone Company has an exchange, and the only reason a franchise was granted to a second company was to secure lower rates. The citizens declare there is collusion between the two companies and are looking about for some effective remedy.

JEFFERSONVILLE, IND.—The telephone girls, twenty-five in number, have recently given the Cumberland Telephone Company five days in which to arrange for better comfort, lest they will strike. The girls operating the local exchange are not allowed to use fans and the company will not put in electric fans. The night operators want screens put in the windows and doors to keep out the immense and numerous Ohio river mosquitos and bugs. The local manager says his superiors have prevented him furnishing these necessary conveniences.

MELROSE, IDA.—The long distance telephone line owned by J. W. Burton and W. E. Schruebly, of Melrose, and C. W. Green, of Lenore, Ida., is completed into Lewiston, Ida. This gives communication to all the reservation towns.

FONDA, IA.—The Northern Telephone Company, of Fonda, is to build a new line out of Fort Dodge, running north to Humboldt, thence west to Gilmore City, Pocahontas and Storm Lake.

MITCHELLVILLE, IA., will have a new and independent telephone system. It will be completed and ready for use by September 1. Plans are well under way for this new enterprise. A company has been formed with $10,000 capital and will be incorporated with the following officers: President, J. B. Uhl; secretary, B. R. Patterson; treasurer, S. I. Oldfield.

PERRY, IA.—The city council has ordered that the Hawkeye Telephone Company reduce its telephone rates to $12 per year for residences and $18 per year for business houses. This is on a report showing rates in other cities. The franchise provides that the rates shall not exceed those of the average in any five cities of the State of the same size and having approximately the same number of telephones.

WELLINGTON, KAS.—The city council has granted a franchise for a rural telephone system to place wires and poles in the city. The system is backed by John T. Stewart, George T. Pitts, G. T. Hackney and T. F. Randolph. Work on the new plant will begin at once and the main office is to be in Wellington.

BEDFORD, KY.—The Cumberland Telephone Company is putting in a new exchange and running its lines throughout the county.

OWENSBORO, KY.—The Cumberland Telephone & Telegraph Company has brought suit against the Rough River Telephone Company to restrain it from stringing its wires in certain places, charging that its own service is thereby interfered with.

DETROIT, MICH.—The Detroit Co-operative Telephone Company is pushing its construction work and subscriptions are coming in fast. Mr. C. M. Burton, the president, says that the cables will be there by Sept. 1; that they ought to have between 500 and 600 telephones working by the latter part of October.

DETROIT, MICH.—At a meeting of the board of directors of the Citizens' Telephone Company the twentieth consecutive quarterly dividend of two per cent. was declared, the checks for which will aggregate $16,000. During the year ending July 1, 935 subscribers have been added, and in all departments the company is in a most flourishing condition.

FERGUS FALLS, MINN.—The Fergus Falls Telephone Company is about to install an exchange in the village of Parkers Prairie. The company has completed a long distance line to the village.

ST. LOUIS, MO.—The movement against free telephones in St. Louis started by the druggists is being taken up by other business men who keep free telephones for their patrons.

BEATRICE, NEB.—A twenty-year franchise to operate a telephone line in Beatrice has been granted by the city council to the R. V. Montague Investment Company of Kansas City.

YORK, NEB.—The Independent Telephone Company has just built a line through New York Township and a large number of farmers have subscribed for telephones. The Independent company now has connections with Waco, Benedict, Bradshaw and Arborville, and in a short time will have instruments in every township in York County.

ALBANY, N. Y.—The Davis Telephone Company of Kortright, Delaware County, has been incorporated. Capital, $10,000, and directors: Ferris E. Davis, James K. Penfield, Andrew J. Nicoll, of Delhi, and others.

JAMESTOWN, N. Y.—The Home Telephone Company has elected officers as follows: Jules Voutrout, president; P. H. Hoyt, vice-president; C. B. Selby, secretary M. M. Skiff, treasurer. The above with G. B. DeVoe, C. W. DeVoe and Edgar Putnam are directors. The company will inaugurate service about August 1 with 1,200 subscribers. The company is owned largely by people from Warren, Ohio.

BUFFALO, N. Y.—The Rural District Telephone Company is busily engaged in the erection of poles and the stringing of wires throughout Orleans County. The company was organized for the purpose of benefiting the farmers in the rural communities. The service that the company will offer to its subscribers is unlimited. The rate for the first year for residences will be $20 and for business places $26. For the second and subsequent years the rates will be $6 for residences and $9 for business places. In case the subscribers buy the telephones the rates are $10 a year for residences and $12 a year for business places.

CALEDONIA, OHIO.—The Marion County Telephone Company has secured a franchise for an exchange in this town.

COLUMBUS, OHIO.—The East Telephone Company, of Jefferson County, has been incorporated with $6,000 capital.

EAST SPRINGFIELD, OHIO.—The East Springfield Telephone Company has been incorporated with $6,000 capital stock to build a local exchange.

JOHNSTOWN, OHIO.—The new independent exchanges at Johnstown and Croton are about completed. They will be connected with Newark and Utica.

URBANA, OHIO.—The Urbana Telephone Company increased its capital stock from $5,000 to $10,000. C. H. Marvin is the president and J. C. Powers, secretary.

NEWARK, OHIO.—The Newark Home Telephone Company has placed a contract with W. H. Crumb & Company, of Chicago, for the complete reconstruction of the Newark exchange. It will be altered to the central energy system.

URBANA, OHIO.—The Urbana Telephone Company has increased its capital stock from $50,000 to $100,000. One half of the new issue has been subscribed pro rata among the old stockholders. The company has made many improvements of late.

COLUMBUS, OHIO.—The officials of the Columbus Citizens' Telephone Company have practically decided to install a new automatic switchboard. The company has been planning extensive improvements to take care of required extensions and it now seems quite probable that the entire system will be rebuilt and made automatic. The company has about 5,000 subscribers.

CLEVELAND, OHIO.—The bankers' committee in charge of Everett-Moore affairs continues to dispose of the subsidary properties of the Federal Telephone Company and it seems probable that in the near future only a very few exchanges will be left in the hands of the Cleveland people. The Portsmouth Telephone Company, of Portsmouth, was sold a few days ago to Judge J. M. Thomas and others. The property will be improved at once. The Willoughby Telephone Company, of Willoughby, has been sold to Fred Storm and others who have been identified with the company. The price is said to have been $7,000. The Stark County Telephone Company's pool formed for the purpose of developing the exchanges at Canton, Alliance and adjoining towns, has been closed and the securities have been distributed through the Savings & Trust Company. The company had an authorized capital of $500,000, but only one half of this had been issued. Negotiations for the purchase of the People's Telephone Company, of Detroit, are still on.

CLEVELAND, OHIO.—Barney Mahler, representing the Cuyahoga Telephone Company, appeared before the board of control and made an appeal for a change in the franchise of the company to enable it to charge higher rates for service. It is claimed the company has 10,000 subscribers and is losing money because of its growth. The company wants to increase the rates for business service from $48 to $72 per year. The board of control is considering the matter and will investigate the company's books before making a recommendation. It is believed, however, that the city council will be unable to take any action in the matter because of the injunction granted by Judge Caldwell against the city council, restraining that body from granting any company or persons any franchise or special privilege for the use of the city's streets. The intention of the council to favor the Cuyahoga company was one of the measures against which injunction was asked. It is claimed that no action can now be taken until a decision is rendered by the supreme court.

WESTERLY, R. I.—The Westerly Automatic Telephone Company has been formed under a special act of the legislature and has organized with the following board of directors, composed of prominent local professional and business men: John Champlin, M. D.; Albert B. Crafts, George C. Bartrum, William S. Slocum, Robert A. Sherman, George L. Stillman, Thomas J. Bannon and James A. Welch. The company has adopted the Strowger automatic telephone system and has ordered 100 telephones and switchboard with an ultimate capacity of 1,000. The first carload of material has arrived and the work of installing the plant is now actively under way. Joseph B. Baker, of Boston, for many years connected with the experimental department of the American Bell Telephone Company is consulting engineer and Mr. O. S. Bowen, formally with the New Bedford and Fall River Automatic Telephone Companies, is Superintendent of Construction. It is hoped to open the exchange for service by September 1st. It is proposed to extend the service to Watch Hill, Stonington, Noyses Beach and other surrounding towns in the Spring.

SUMTER, S. C.—The Bell Telephone Company is making a strong effort to secure a franchise in Sumter. The franchise is opposed by the local company which holds a ten-year franchise.

COLUMBIA, S. C.—The South Carolina Long Distance Telephone Company has added to its connections the towns of Hartsville, Darlington and Society Hill. During the next few months the company will devote its attention to rebuilding its lines in the Pee Dee section, changing them into metallic circuit lines.

PECAN GAP, TEX.—The North Texas Telephone Company of Pecan Gap, Delta, County, Tex., has been incorporated by W. A. Cockrell, W. R. James and J. H. Gordon, with a capital of $5,000.

GALVESTON, TEX.—Assistant General Manager G W. Foster, of the Southwestern Telephone & Telegraph Company, has been in Galveston, Tex., inspecting the local exchange and arranging for the laying of the new cables in underground conduits. He states work will be completed by September.

THE ROCKY MT. BELL TELEPHONE COMPANY is erecting new poles, to be occupied by the company and the electric light company at Lehi, Utah.

OGDEN, UTAH.—The Rocky Mountain Bell Telephone Company has asked the city of Ogden, Utah, for an extension of its telephone franchise for fifty years. The present franchise has eight more years to run. It is understood that no trouble will be encountered by the company in getting the extension.

SEATTLE, WASH.—The Independent Telephone Company, of Seattle, Wash., has been granted an extension of 60 days to complete its system.

OAKESDALE, WASH.—The Granite Hill Telephone Company of Oakesdale, Wash., has completed its line from Thornton to Oakesdale. Over $400 has been raised by public subscription for an exchange in Oakesdale.

HARTFORD, WIS.—The Wisconsin Telephone Company is extending its lines from Hartford to Mayville, serving the towns of Rubicon, Woodland, and Iron Ridge with a metallic circuit.

PLATTEVILLE, WIS.—The consolidated farmers' telephone company have secured forty-two subscribers to their telephone system in this city and have purchased a 100-drop switchboard of the Elston Telephone and Electric Manufacturing Company, of Muscoda, which will soon be installed.

ELECTRIC LIGHT AND POWER.

SONORA, CALIF.—The Main River Ditch Company has revived its electric power project. It is claimed that 35,000 hp can be generated at the mouth of the ditch. Power lines to Stockton, San Jose and Oakland, Colo., are projected. The engineering work is in charge of Wm. Hammond Hall, and M. H. Walsh, of Sonora, is interested. The water of the Stanislaus River is to be used—head 2,200 feet.

SISKIYOU, CALIF.—The Siskiyou Electric Power Company is reported to have commenced work on its projected electric power transmission system in Siskiyou County, Calif. E. H. Steel is manager of the company, which proposes to take water from Fall Creek where it flows into the Klamathon River. It is said that 2500 hp can be developed. Light and power will be supplied to the mines near the plant and a pole line will be built to Yreka.

THE CALIFORNIA POWER COMPANY is now in a position to complete its projected electric transmission system from the Kern River Canyon to Los Angeles. Bonds in the sum of $3,000,000 have been placed in Chicago and the financiers are ready to take the remainder of the $10,000,000 bond issue, which was authorized, when needed. The right of way across the Forest Reserve in Southern California has been granted and there is no reason for further delay in the construction of the plant.

ALAMEDA, CALIF.—The Suburban Electric Light & Power Company which distributes the current of the Standard Electric Company's transmission system, has offered to supply the city of Alameda, Calif., with current at a rate lower than the cost of production by the municipal electric lighting plant. The City Cleek has been instructed to advertise for bids for electric current delivered at the switchboard in the municipal plant. Superintendent Wiese, of the municipal electric system, is in favor of the change. Fuel now costs $700 a month at the city plant and $370 per month could also be saved in salaries.

SAN FRANCISCO, CALIF.—The United Gas & Electric Company, which was organized as a distributing agent for the current from the Standard Electric Company's electric transmission system, is rebuilding the Pacific Power Company's underground conduit system in San Francisco. A controlling interest in the latter company is held by the United Company. The Standard Electric Company's current now reaches the substation at the intersection of Kansas Street and Division Avenue, but it will not be put into commercial use until the distributing system is placed in proper condition. Rates are being cut for electric lighting current in the competitive districts and there is no definite prospect of a consolidation of lighting interests in the city.

CRIPPLE CREEK, COLO.—The Golden Wedge mine of Cripple Creek, Colo., is installing an electric hoist, pumps, etc.

DENVER, COLO.—The Denver Gas & Electric Company has not purchased the Lacombe Electric Company, as has been reported.

CRIPPLE CREEK, COLO.—The Emma Mining Company, of Cripple Creek, Colo., will install an electric light and power plant at their mine.

DENVER, COLO., may have a site for a dam on Tarryull Creek, in Park County, provided it buys and gives the owner, F. F. Nixon, the privilege of using the water to generate power. Mr. Nixon has laid his plans before Mayor Wright of that city.

LEADVILLE, COLO.—It is reported that eastern capital will at once start building a power plant in Leadville, Colo. The plant will be located at Malta, having a capacity of 5,000 horse power, and this power the new company has agreed to sell to the mines at $136 per hp per annum. The mines are now paying about $240 per hp per annum, using coal as fuel.

DENVER, COLO.—O. S. Adams has been appointed receiver of the Grand Junction (Colo.) Electric and Manufacturing Company by United States Judge Hallett, on application of the Morton Trust Company of New York, which claims that the electric company is indebted to it to the amount of $50,000, having defaulted interest on its bonds for two years.

BRIDGEPORT, CONN., Mr. G. C. Batcheller, corset manufacturer, is putting in a new electric light plant. McClave, Hamilton & Co., of New York are the contractors.

KEY WEST, FLA.—On July 26, William Curry and Son's ice and electric plant was blown up. Two firemen were killed and six men were wounded. The plant is a complete wreck. No cause for the accident is given. The explosion caused great excitement in the city.

WEISER, IDA.—The town of Weiser, Ida., will spend $3,500 on a small electric light plant.

BOISE, IDA.—The Payette River Power Company has secured a franchise to build its pole line through the city of Boise, Ida.

LEWISTON, IDA.—A proposition has been presented to the city council of Lewiston, Ida., by the electric light company to furnish the city with water; the electric company will put in a large electric pumping plant if proposition is excepted.

ALBION, IDA.—The committee appointed to report on the proposed municipal electric light plant at Albion, Ida., reports that the plant could not be built under the present conditions less than $6,000, which is considered too much for the resources of the town. The matter has been dropped.

NEW CASTLE, IND.—The Newcastle Electric Light, Power & Heat Company recently organized, hopes to erect and equip a plant before winter.

ST. FRANCISVILLE, LA.—An election will be held on an issue of $10,000 bonds for water and electric lights.

NEW ORLEANS, LA.—The Sewerage and Water Board, F. S. Shields, secretary, will receive bids until Aug. 12 at 12 M. for furnishing and erecting all machinery, dynamos, etc., for a central pumping and generating station.

LIVERMORE FALLS, ME.—The Livermore Falls Light & Power Company, Edwin Riley, president, has an authorized capital of $100,000, and offers free use of land on railway lines to those who will erect establishments. The company employs the Edison system, and has 15 miles of circuit.

NEWBURYPORT, MASS.—The Newburyport Gas & Electric Company, Newburyport, Mass., will erect a new electric plant to cost about $50,000. D. D. Tilton is general manager, and C. S. Spaulding, superintendent.

GREAT BARRINGTON, MASS.—The Great Barrington Electric Light Company is to enlarge its plant and has leased from P. A. Russell the water power and woolen mill of the woolen company. The mill will be fitted up with machinery with which to supply power. The plant will be run in connection with the station at Housatonic. The company has recently had many applications for power which it has been unable to furnish. The Stanley instrument Company propose to run their plant by electricity. Mr. P. A. Russell will manage the company.

ZEELAND, MICH.—A. Lahnis, secretary of the local Board of Public Works, has plans and specifications for a 1500-light electric plant and water works and bids are asked for equipment.

YAZOO CITY, MISS., will issue $200,000 bonds for the construction of water works, sewage and electric light plants.

EAST ST. LOUIS, Mo.—E. W. Clark & Co., of Philadelphia, have purchased the Citizens' Electric Light & Power Company plant in East St. Louis for $600,000.

SALEM, N. J.—The Salem Electric Company is to build a new power plant, including one 80-kw 60-cycle and one 65-kw 60-cycle Stanley light machine; one 125-hp 4-valve and one 90-hp single valve Russell engine. The current will be delivered to Pittsburgh transformers, and Helios-Upton arc lamps.

IVY, N. C.—The big electric power plant at Ivy will be enlarged, as the available water power has proved greater than expected.

MORGANTON, N. C.—M. B. Wilkerson, of Asheville, and Philadelphia associates, are endeavoring to interest a New York syndicate in developing falls on Linville river, where 20,000 hp is available. It is proposed to distribute this power along the line of the Southern railway. The river has a fall of about 2,000 feet in eight miles embraced in the holdings of Mr. Wilkerson and associates.

BRIDGETON, N. J.—The Bridgeton & Harrison Electric Company has a capital of $50,000 and operates ten miles of circuit, using Westinghouse apparatus. About 1,500 16-cp lights are operated. The company was formed in 1895.

CHATEAUGAY, N. Y.—The Chasm Power Company, which was formed June 27, has a capital of $20,000 and capacity for furnishing 2,500 lights. The company is now constructing the dam.

FISHKILL LANDING, N. Y.—The Citizens' Railroad, Light & Power Company, of Fishkill Landing, N. Y., has received consent from the State Railroad Commission to increase its capital stock from $100,000 to $175,000 and to issue $100,000 bonds.

BUFFALO, N. Y.—Edmund Hayes, of Buffalo, one of the men chiefly interested in the new Ontario Power Company of Niagara Falls, Ont., the concern organized to develop electric power on the Canadian side of the river, has confirmed the report that an American company had been formed to take care of business on this side of the river. The name of the American company is the Ontario Power Transmission Company, and its directors are John J. Albright, Edmund Hayes and George S. Field, of Buffalo, and J. S. Simmons and S. P. Franchot, of Niagara Falls. Mr. Albright is president, Mr. Hayes, vice-president, and Raymond K. Albright, treasurer. The two corporations are practically identical, the same men being interested in both.

CONNEAUT, OHIO.—The P. & C. Dock Company will erect an electric light and power plant.

MILLERSBURG, OHIO.—Citizens of this place are negotiating for the erection of an electric lighting and hot water heating plant.

COLUMBUS, OHIO.—The Columbus Edison Electric Light Company has purchased a site opposite its present plant and will erect an addition.

NEW BREMEN, OHIO.—A proposition to issue bonds for a municipal water works and electric lighting plant has carried at a popular election.

COLUMBUS, OHIO.—J. A. Erner & Company, of Cleveland, have secured the contract for installing an electric lighting plant in the State institution for the blind.

COLUMBUS, OHIO.—The City Clerk has been ordered to advertise bids for the building and equipping of the municipal lighting plant after plans prepared by Director Immel.

MANSFIELD, OHIO.—The county commissioners have directed the county auditor to issue $10,000 in bonds to equip a power house with which to illuminate the county buildings.

WYOMING, OHIO.—The Cincinnati Gas & Electric Company is negotiating for the purchase of the plant and business of the electric light company at Wyoming. The company holds franchises and contracts in Wyoming and Lockland.

COLUMBUS. OHIO.—The Columbus Lighting & Heating Company has been incorporated with $10,000 capital stock by J. W. Barber, J. D. Karns, Wm. T. Mills, J. S. Barber and F. E. Hoover. The company proposes to furnish electric light and hot water heating.

CLEVELAND, OHIO.—B. P. Foster, who has applied for a city franchise to furnish electricity for "fuel, heating and power purposes," admits that the chief aim of his company is to furnish light throughout the city. It is probable that the city will call for bids before granting the company a franchise.

HAMILTON, ONT.—The Hamilton Electric Light & Cataract Power Company has arranged to have a steam plant manufactured for the company and installed at the Victoria Avenue substation in the city. This new plant will be put in next year. It will have a capacity of 3,500 hp, and is calculated to insure a continuity of service even under the most unfavorable circumstances.

BAKER CITY, ORE.—A. B. Frame, representing eastern capital, is in Baker City, Ore., looking over the ground for the erection of the new proposed light and power plant to be established on Eagle Creek. The plant will cost $300,000.

YORK, PA.—The York County Traction Company has completed the erection of a power station at Red Lion. Several electricians from Philadelpia have just completed the wiring of the building.

PETROS, TENN.—The new electric power house of the State coal mines at Petros has been completed and is being equipped. This is said to be one of the best equipped plants in East Tennessee.

YORK, PA.—The charter of the City Arc Light and Power Company has been received. The company is capitalized at $1,000, and the directors are L. M. Hartman, J. F. Julius, R. H. Shindel, Granville Hartman, Jr., J. Herbert Thomas and William T. Gerber.

JOHNSTOWN, PA.—John D. Roberts, Dr. W. B. Lowman, Joseph Morgan, H. H. Weaver, Charles R. Glock, M. L. Woolf and C. S. Price are named as the incorporators of the Citizens' Light, Heat and Power Company, which will apply for a State charter Aug. 8. When a State charter has been granted, application will be made to councils for a franchise to operate in the city The plans for a light, heat and power plant have already been completed, and everything is ready for the company to go ahead as soon as the requisite papers have been secured

SHERBROOKE, QUE.—An offer has been made the Sherbrooke Gas & Electric Company by a syndicate, including American capitalists, to purchase the concern at $78 per share. The capital stock of the electric company is placed at $200,000. It is reported that the new company is after the Sherbrooke Street Railway and the People's Telephone Company. It is stated that if the offer of the syndicate for the Gas Company is accepted, the other concerns will be also merged. There is a considerable amount of feeling excited in the city over the action of this syndicate, in view of the fact that the City Council recently purchased a water power for the purpose of supplying light to the city.

NASHVILLE, TENN.—The Secretary of State has granted a charter to the Cumberland Manufacturing Company, of Nashville, organized for the purpose of manufacturing electricity for light and motive power. The capital stock is $12,000 and the incorporators are James E. Caldwell, Charles H. Brandon, Reau E. Folk and William L. Granbery.

GILMER, TEX.—The Gilmer Electric Light Company has been formed; capital stock, $4,000. The incorporators are J. F. Croley, T. C. Mitchell and C. H. Beckner.

BEAUMONT, TEX.—The Eclipse Power Company of Beaumont has been formed; capital stock, $10,000. The incorporators are H. R. Becker, W. A. Paddock, R. W. Griswold.

BEAVER, UTAH.—Construction work upon the big power plant in Beaver Canyon planned by the Majestic Company will be commenced at once and pushed to completion with all possible speed. The current will be conducted to the mines of the company beyond Milford and to the smelter to be erected at Milford for lighting and power purposes. Owing to the scarcity of fuel and water, the use of electricity will effect a great saving in the cost of operating the mines and reduction works. It is the intention to convey the current as far as Copper Gulch, a distance of fifty miles, and furnish 500 hp to the Cactus, Mr. Newhouse having entered into a contract to take this amount of power for his mine and concentrator.

RICHFIELD, UTAH.—W. A. Miles has located his power house to supply Richfield and Elsinore, Utah, with light and power, on the Sevier River, about five miles from Richfield. A fall of 231 will be had and about 340 horse-power will be developed.

TOOELE COUNTY, UTAH.—The Clark Electric Light & Power Company of Tooele County, Utah, is erecting a pole line to carry power to the big Honerine Tunnel at Stockton.

PARK CITY, UTAH.—The electric light company at Park City, Utah, is placing meters through the city, as the flat rate will be abandoned.

DAYTON, WASH.—Mr. Mellmunn, proprietor of the Dayton-Pendleton (Wash.) electric road, located a site for a power house about sixteen miles from Dayton. This plant will also supply power to Pomeroy, twenty-seven miles away.

MANNINGTON, W. VA.—The Mannington Electric Light Company has completed plans for a new plant which will be erected in the near future.

SARATOGA, WYO.—The new light plant at Saratoga, Wyo., which has just started operation, has in place a 80-hp boiler, 125-hp Ball engine direct-connected to a 1200-light generator. Space has been provided for an additional boiler and three generators if desired.

THE ELECTRIC RAILWAY.

SAN JOSE, CALIF.—An ordinance has been passed to print in San Jose, Calif., announcing the sale of the electric street railway franchise applied for by L. A. Sage. It calls for a single track electric road from San Jose to Saratoga and Los Gatos.

THE CALIFORNIA PACIFIC RAILWAY, which will build and operate the Los Angeles Tranction branch from Los Angeles to San Pedro, has commenced work on the foundations of the new power house on Pico Street. It will be 150x150 feet and the equipment thoroughly modern.

LOS ANGELES, CALIF.—The Los Angeles Pacific Railway Company of Los Angeles, Calif., will electrify the steam motor line extending from the terminus of the Temple Street line to Hollywood through the oil district. The road will continue to transport oil and other freight, and a passenger service will be added.

SANTA ROSA, CALIF.—An application for a franchise for an electric street railway in Santa Rosa, Calif., was recently presented at a city council meeting by S. N. Griffith. The route of the proposed road covers the principal streets in the city and suburbs. The City Council has declared the Central Street horse-car line a nuisance, thus opening the way for an electric line.

MACON, GA.—The three street car systems of Macon have been merged and the new management will take charge on August 1. A combination was formed between the owners of the Macon and Indian Springs Line, the Savannah Trust Company, J. P. Williams' Sons, of Richmond, Va., and Middeldorf & Co., of Baltimore, who paid over $300,000 for the other lines. Thomas J. Carling, of Macon, will be president of the new organization.

NEW PALESTINE, IND.—The city council has granted a franchise to Charles L. Henry for the Indianapolis & Cincinnati Traction Line—a new enterprise being promoted by Mr. Henry.

WINCHESTER, IND.—A new interurban company was incorporated on the 17th of July, to be known as the Winchester & Muncie Interurban Company to build a line from Union City to Muncie. James E. Lowes is president. The power house will be located at Winchester, a site having been donated.

LOGANSPORT, IND.—The Cass County Commissioners have granted a franchise to the Logansport, Rochester & Northern Traction Company to extend its lines through Spencer Park over a public highway. This is a great victory for the McCullough interest and a severe blow to the local street railway company, which has been fighting the Northern company at every turn.

RICHMOND, IND.—The contract has been let for the construction of the Hamilton, Eaton & Richmond traction line, the project promoted by G. M. Hodges, of Dayton. It went to Falk Brothers, of Milwaukee, who were the lowest bidders. This firm is to construct the grade, lay the track, erect the trolley line, furnish cars and erect fifteen stations.

RICHMOND, IND.—The Falk Company, of Milwaukee, has begun on the contract for the construction of the Hamilton, Eaton & Richmond Traction Company's line. Work on the line will start as soon as possible at Hamilton, Richmond and Eaton. The company will have charge of all contracts. Ten 62-ft. coaches will be ordered at once. The road is to be completed within one year.

MARION, IND.—The City Council has taken summary action against the Marion Transit Company and ordered it to tear up all its tracks in the streets and put the latter in good order within thirty days. If not complied with the city will sue for $50,000 damages against the stockholders. The cause of the council's action was the act of the Union Traction Company in tearing up a street without permission and in the night time and connecting its tracks with a line of the Marion Transit Company, the franchise of which had been revoked by the council.

ANDERSON, IND.—At a meeting of the stockholders of the Union Traction Company on the 17th inst. it was voted to lease the Indianapolis and Northern lines. They also passed a resolution of consolidation by which all the branch lines will be under the control of the Union Traction Company. The final step in merging all these lines was taken the next day when the Indianapolis-Northern filed with the recorder of Indianapolis a $5,000,000 mortgage on its property to the Colonial Trust Company of New York with the Union Traction

company as guarantee, to secure an issue of $5,000,000 of bonds. The work of completing all these branch lines will now be pushed and when completed will be the greatest interurban system in the world, it is claimed.

LOUISVILLE, KY.—About $50,000 has been subscribed by local capitalists towards a proposed electric line between New Albany, West Baden and French Lick Springs. W. H. Newbury, of the Baden-Lick Sulphur Springs Company, is interested. He states that when $250,000 is subscribed work will begin.

CONCORD, MASS.—The Railroad Commissioners of Massachusetts have approved an issue of bonds to the amount of $165,000 by the Concord, Maynard & Hudson Street Railway, to refund floating indebtedness incurred in building and equipping the road.

OWOSSO, MICH.—The Owosso & Corunna Electric Company which operates a line between the towns mentioned in the title, is to be reorganized and the line will be extended to Durand, twelve miles.

OLIVETTE, MO.—M. B. Greensfelder has filed a petition in St. Louis for the privilege of building an electric or horse power street railway about three miles long. Olivette is a suburb of St. Louis.

ST. LOUIS, MO.—The St. Louis Terminal Depot Company has been organized to bridge the Mississippi and perform other important work. Among other things the company asks for franchises for right of way over about ten miles of city streets and the privilege of operating by either steam or electricity. J. C. Van Blarcom and others are the corporators.

ATLANTIC CITY, N. J.—Note is made of the incorporation in New Jersey of the Atlantic City and Suburban Traction Company with a capital of $500,000, to build a line from Atlantic City to Pleasantville, N. J.

PRINCETON, N. J.—The Johnson Trolley Company has completed its line through Witherspoon Street, in Princeton, to within 100 yards of the campus. After much opposition the company secured a franchise last spring and the line is already in working order.

NEW BRUNSWICK, N. J.—The Trenton and New Brunswick Railroad Company, which is building a line between Milltown, near New Brunswick and Trenton, is securing options on land on the northern side of the Raritan River and then the company intends to extend its line to Elizabeth. The road is to extend from Milltown to the Raritan River and cross by means of a trestle bridge at a point known as Martin's Dock, about two miles below New Brunswick. The road will then continue to Elizabeth, passing south of Metuchen, Rahway, and Linden.

GLOVERSVILLE, N. Y.—A project for an electric line from Cornwall to Toronto is being rapidly pushed by American and Canadian promoters, who have a capital of $8,000,000.

NEWBURG, N. Y.—The Intervale Traction Company, to operate a 28-mile electric railroad from Newburg to Goshen, has been incorporated with $300,000 capital. Directors: Hiram B. Odell, Graham Witchie, Newburg; Charles D. Hobbs, Louis W. Slotensbury, New York.

MOUNT VERNON, N. Y.—The local Board of Aldermen has granted permission to the Port Chester Railroad Company to build its railroad through the city. There were no restrictions as to fares or any other point, except that the railroad is to be built and operated under the restrictions of the State Railroad Commissioners. When the meeting was called to order there were about 500 citizens present, who urged the board to grant the railroad company permission to build its road.

FRANKFORT, N. Y.—Horace E. Andrews, president of the Cleveland Electric Railway and J. J. Stanley, general manager of the company, have been in New York preparing for a development of their New York properties. Two years ago the syndicate obtained a control of the Utica Belt Line Company and built lines to Frankfort, Rome, Utica and Clinton. Negotiations are now on to purchase the Rome City Railway at present using compressed air cars. The syndicate is building a line from Frankfort to Little Falls and another from Clinton to Oneida, giving its trunk line from the latter city to Little Falls 50 miles. The line will be double track throughout and will parallel the New York Central Railway. Freight service will be institued to compete with the steam road.

BRILLIANT, OHIO.—The Ohio Valley Traction Company is planning to erect a car barn and power station at Brilliant and work will start in the near future.

LIMA, OHIO.—The city council has granted a franchise to the Lima, Delphos, VanWert & Ft. Wayne Traction Company over a route established some time ago.

CINCINNATI, OHIO.—The Cincinnati, Milford & Goshen Railway has been given a franchise to build a spur line into the grounds of the Cincinnati Camp Meeting Association.

SPRINGFIELD, OHIO.—The Springfield, Piqua & Sidney Traction Company has applied for a franchise on Bechtel Avenue, with a view to securing entrance for its new suburban line.

EATON, OHIO.—The Hamilton, Eaton & Richmond Traction Company has secured a 25-year franchise from the county commissioners. The road must be completed by July 4, 1903.

SEBRING, OHIO.—The Stark Electric Railway has been granted a perpetual franchise to operate through the streets of Sebring. The power house near that place is nearly completed.

FINDLAY, OHIO.—The Toledo, Bowling Green & Southern Traction Company is building a new power station near Cygnet. When completed the facilities of the road will be greatly improved.

DAYTON, OHIO.—A new company of Dayton capitalists have obtained an option on the old Reading turnpike between Cincinnati and Lebanon and propose to build an electric road following the route.

SPRINGFIELD, OHIO.—Harry Frey, Jr., promoter of the Springfield-Hillsboro lines, announces that he has succeeded in disposing of the bonds for the new road and states that construction work will start within six weeks.

TOLEDO, OHIO.—The Toledo Railways & Light Company has obtained a tract of about thirty acres of land on the W. & L. E. Ry., and is planning to erect large car barns, repair shop and storage house for interurban and city cars.

CINCINNATI, OHIO.—The Cincinnati & Eastern Railway Company has received a large shipment of red cedar poles from Idaho for use on the new line between Cincinnati and New Richmond. Work on the line is progressing rapidly.

CINCINNATI, OHIO.—It is announced that the Columbus & Cincinnati Traction Company has secured all required right of way for a 119-mile line between the two cities and that negotiations are being made with eastern contractors to build the road.

HAMILTON, OHIO.—J. C. Hooven, president of the Cincinnati, Hamilton & Indiana Traction Company has made application to the county commissioners for a franchise from Hamilton to College Corner and Oxford. All required consents have been obtained.

MARIETTA, OHIO.—The Parkersburg, Marietta & Interurban Railway Company recently organized under West Virginia charter with $440,000 capital stock, has been authorized to do business in Ohio. The road is now in operation from Parkersburg to Marietta.

CLEVELAND, OHIO.—The Eastern Ohio Traction Company has secured much of the right of way for an extension from Middlefield to Sharon, Pa., by way of Bloomfield, Greene, Gustavus, Kinsman and Orangeville, about 38 miles. Courtland citizens are endeavoring to have a spur line touch their town.

YOUNGSTOWN, OHIO.—Park & Hamilton, who organized the Youngstown & Southeastern Railway to build a line to Struthers, have withdrawn in favor of the Pennslyvania & Mahoning Valley Railway, which proposed to build over the same route, and Park & Hamilton have taken the contract for building the line.

NEW RICHMOND, OHIO.—The Cincinnati & Eastern Traction Company, which is building to New Richmond, will have river connection with Augusta, Ky., arrangements having been completed for a large passenger steamer to ply between the towns. This will enable the company to compete with the C. & O. (steam) for business on the Kentucky side.

COLUMBUS, OHIO.—The Greenville & Union City Traction Company has been incorporated with $10,000 capital stock by Dr. J. E. Lowe, J. E. Feight, W. B. Gebhart, R. H. Deweese and C. M. Anderson. The road will be an extension of the Dayton & Northern, which is owned by the same people. Contracts for the construction work have been placed.

TOLEDO, OHIO.—Charles P. Griffin, G. G. Metzger and W. T. King and others who are interested in several Ohio traction roads, have organized a company to build the Bloomington, Peoria & Pekin Railway. Right of way has been secured between Bloomington and Pekin, Ill., and work will start as soon as the balance has been secured, which will be in the near future.

NORWALK, OHIO.—The Lake Shore Electric Railway Company has obtained a franchise for a new line in Norwalk, affording a better entrance for the Norwalk-Sandusky division of the road. The company has received permission to relay its tracks in town with 70-pound T rails instead of the girder rails now in use. A special nosed brick is to be used inside of the track adjacent to the rails.

COLUMBUS, OHIO.—The merger of the Columbus, Buckeye Lake & Newark Traction Company, the Newark City Street Car Company and the Newark & Granville Traction Company has been effected under the title of the first mentioned company. Officers have been elected as follows: P. L. Saltonstall, Boston, president; Chauncy Eldredge, Boston, secretary-treasurer. The above, with J. R. Harrigan, M. J. Loftus and C. A. Alderman, of Newark, are directors.

CLEVELAND, OHIO.—R. L. Andrews, of the Eastern Ohio Traction Company, and Barney Mahler, of the Lake Shore Electric Railway, have been appointed a committee by the Cleveland interurban roads to negotiate with the officials of the city companies with a view to the speedy construction of the union freight station already started on Bolivar Street. The plan is to induce the city companies to build and operate the freight station. The freight business of all the Cleveland roads is being held up because of inadequate terminal facilities.

KINGSTON, ONT.—Folger Bros., of Kingston, Ont., who have the controlling interest in the street railway company of that city, are now arranging to utilize the water privileges at Kingston Mills for creating power for car service and for supplying the public. This proposition is contingent upon the city acquiring the present electric plant, the price for which was fixed by arbitration, but is now in the courts for readvisement on the appeal of the electric company.

WINDSOR, ONT.—An American civil engineer is inspecting the topography of the country between Windsor and St. Thomas, Ont., for a syndicate which, it is said, means to build an electric railway between the two cities. It is proposed to have the line parallel the system of the Michigan Central and the Lake Erie and Detroit River Railway, through a rich and populous district, the residents of which have now to haul their produce a long way to the railway stations. Just who is behind the movement for the new road is not disclosed.

HULL, QUE.—The Hull Electric Railway, which runs through the city of Hull from a terminus at Ottawa to Aylmer, Que., is now owned and operated by the Canadian Pacific Railway Company. The Gatineau & Pontiac Railway systems, which were amalgamated with the Hull electric line, were acquired some time ago by the Canadian Pacific, the present deal being part of that purchase. The price paid for the electric system is placed at $700.000.

HAWKINS, TENN.—The County Court of Hawkins, Tenn., has voted to issue bonds to the amount of $100,000 in aid of an electric railway.

NASHVILLE, TENN.—The court of chancery appeals has delivered a decision invalidating the consolidation proposed by the constituent lines of the Nashville railway. The city held that the consolidation was effected in 1900 without its consent. The consolidated properties are bonded at $6,500,000.

BEAUMONT, TEX.—The Beaumont Street Railway Company will shortly open its line for traffic. The power house is completed and track laying is being pushed. Lack of steel has held up the company for many months.

DALLAS, TEX.—A. K. Banta, representing the United Electric Securities Company of Boston, and head of the new Metropolitan Street Railway Company of Dallas, announces that he and associates have purchased the Rapid Transit Electric Street Railway of Dallas. The only competition now against the new concern is the Dallas Consolidated with about 35 miles of trackage.

NORFOLK, VA.—A four-million-dollar first mortgage has been recorded in Norfolk for the consolidation of the Norfolk, Newport News and Portsmouth electric railway systems. Also a first income mortgage of two million dollars has been recorded to the Richmond Trust and Safe Deposit Company.

CLARKESBURG, W. VA.—Hon. J. A. Howard, promoter of the Fairmount & Clarksburg Electric Railway, states that the line between Fairmount and Clarkesburg will be built this year.

OBITUARY.

MISS ELISE NEUMANN.—A special cable dispatch from Berlin of July 24 says: Elise Neumann, the first woman who received the degree of doctor of philosophy of Berlin University, was found dead in bed yesterday in her laboratory here. She had been engaged in experiments in electric chemistry and it is supposed that she accidentally poisoned herself. She was a sister of the African explorer, Oscar Neumann.

PERSONAL.

MR. HENRY FOURNIER, the famous French automobilist, promises to return to the United States in September with a new car of great speed.

MR. GEORGE F. McCULLOCH, president of the Union Traction Company, and Mrs. McCulloch, will sail for Europe the first of August, to be gone two months.

MR. T. W. HOPKINS, local manager of the Citizens' Telephone Company, at Galveston, Tex., has resigned his position. His successor has not been appointed.

MR. S. BERGMANN, the electrical manufacturer, who after a successful career in this country, has been equally successful in Germany, is about to visit this country again.

MR. GEORGE WESTINGHOUSE was a guest at a dinner given in honor of Mr J. Pierpont Morgan by Mr. A. W. Maconochie, M. P., at the British House of Commons on July 24. Premier Balfour was also one of the party.

MR. R. E. GAUNT has been appointed general manager of the Lexington, Ky., Railway Company, succeeding E. C. Hathaway, who has been made general manager of the Norfolk, Portsmouth and Newport News Company at Norfolk.

MR. G. F. BROCKMAN, for the past three years superintendent and chief engineer of the Cold Spring, N. Y., Light, Heat & Power Company, has resigned that position and has become superintendent of the Newton, N. J., Gas & Electric Company.

MR. A. E. TOWER, a wealthy metal merchant at Poughkeepsie, whose wife killed herself and a 15-year-old son some months ago, has become engaged to Miss Mary Bogardus, a telephone operator in the Hudson River Telephone Company's exchange at that city.

MR. JOSEPH WETZLER, president of the Electrical Engineer Institute of Correspondence Instruction, of New York, has been suffering from a severe attack of rheumatism and laid up at his Far Rockaway cottage; but a host of friends are glad to learn of his recovery.

MR. H. C. LANG has resigned his position of secretary of the Springfield & Xenia (Ohio) Traction Company and Will Christy has been elected to fill the vacancy. Mr. Lang continues as secretary of the Southern Ohio Traction Company and the Western Ohio Railway.

MR. F. D. ROUNDS, some years ago general superintendent of the Metropolitan Street Railway Company of New York, and well known in street railway and electrical circles, is reported to have committed suicide at Hoboken, N. J., where he was found dead with a bullet wound in his head.

MR. R. S. MASSON, who is one of the incorporators of the Arizona Power Construction Company and consulting engineer for the Huntington-Mellman electrical enterprises in Southern California, returned recently to Los Angeles. He has been inspecting an electric power site in Arizona.

MR. HENRY D. ESTABROOK, a member of the law firm of Loudon, Estabrook & Davis, of Chicago, on Sept. 1, will take charge of the law department of the Western Union Telegraph Company as general attorney for that corporation, succeeding George H. Fearons. His headquarters will be in New York.

MR. C. T. MALCOLMSON, superintendent of power and transmission exhibits in the department of machinery at the St. Louis Exposition, has been on a trip to the East with a view to arranging for apparatus for a temporary or, rather, preliminary plant, which is already very much in demand to meet the calls for power.

MR. EDWARD P. BURCH, as engineer of a municipal electric light plant to be built at Grand Rapids, Minn., has issued a very complete set of specifications for the plant, which are published in pamphlet form. The completeness of the specifications may be surmised from the fact that they occupy forty large octavo pages.

MR. WILLIAM STANLEY contributes an interesting chapter of personal and general electrical history in an affidavit recently made by him in pending litigation between the Westinghouse and Stanley companies. It is a striking review of alternating current development during the last two decades and abounds in dates, references, etc.

MR. J. R. CURTISS has been appointed superintendent of construction on the extension of the Canton-Akron Railway, Ohio, from Navarre to New Philadelphia. Work on the line is progressing rapidly. Mr. Curtiss was formerly at the head of the Curtiss Construction Company, of Cleveland, and has been identified with the building of a number of Ohio roads.

MR. WILLIAM M. RANK has been appointed assistant general manager of the North Shore Railroad Company, California. President John Martin has been acting as general manager since the death of Jerome A. Fillmore. Mr. Rank was formerly connected with street railways in Oakland. The North Shore Company is preparing to build a standard gauge electric road between Sausalito, Mill Valley and San Rafael.

MR. ADOLPHO ASCHOFF, a well-known Brazilian engineer and electrician, has just arrived from Rio Janeiro, and will spend a little time in this country before going on to Europe. He was here last in 1893-4 when attached to the Brazilian Commission at the Chicago World's Fair. Just at present he is carrying out some street railway enterprises and will secure apparatus while in this country, where he has a great many friends and acquaintances.

ROEBLING-ESTABROOK.—At Trenton, N. J., on July 25, the engagement was announced of Miss Blanche Estabrook, of Chicago, daughter of Henry Estabrook, general solicitor of the Western Union Telegraph Company, and a niece of Col. Robert C. Clowry, president of the same company, to Karl G. Roebling, son of Ferdinand W. Roebling and a director of the John A. Roebling Sons' Company. He was graduated from Princeton in the class of 1894.

MR. CHARLES J. SEIBERT, formerly of the Sprague Company, and now electrical engineer for Abraham & Company of Manaos, Brazil, which concern is represented in New York by Bytton Brothers, of 66 Beaver Street, has sailed for Brazil after a visit of several weeks duration in the United States. Mr. Seibert expects to close some half dozen further contracts for small lighting plants somewhat similar to that which has been ordered by the village of Labria, already noted.

MR. A. H. BROOKS, chief of the party which under the U. S. Geological Survey is exploring and investigating in Alaska, has called attention to the extensive water powers existing in the southwestern portion of Alaska. This is the narrow portion of the country, extending southward along the Pacific coast, upon which Juneau, Sitka and Skagway are located. Low grade ores in large bodies are found and can be worked to advantage by making use of excellent water powers, which abound in the region. In the Ketchikan mining district the water powers are available for the entire year.

MR. H. H. PEARSON, JR., president of the New Orleans Railways Company has given out the following list of its officials and staff:Mr. Chas. H. Ledlie, first vice-president; Mr. Jos. H. DeGrange, second vice-president; Capt. John G. Woods, general manager railway department; Mr. Bankson Taylor, general manager gas department; Mr. Alexander Black, chief engineer and electrical department; Mr. E. B. McKinney, superintendent power houses; Mr. H. A. Ferrandou, auditor of the City & Orleans Railroad Companies; Mr. E. J. Morris, master mechanic; Mr. John R. McGivney, purchasing agent.

PROF. A. G. BELL has been very busy lately over his aeroplane. A telegram from Sydney, C. B., of July 28, says: Prof. Alexander Graham Bell has nearly completed his flying machine, which he expects to test very shortly. The machine is being built under his personal direction and is radically different from Santos-Dumont's machine. Every effort has been made to keep secret not only the details of the construction, but the fact that such a machine is being built. Nevertheless, it is reported to be 20 feet long and to be composed of twenty-five distinct parts. It is celled internally with canvas and in places with linen stretched on piano wires. Five miles of this wire were used in the construction. The principle of the kite will be utilized to a considerable extent.

ATTENDANTS AT CONTRACTORS' MEETING.—Up to the present time we have not received the list of those in attendance at the recent annual convention of electrical contractors in Philadelphia, although it was promised officially at the time. Through the courtesy of Mr. Alexander Henderson, who managed the special train from New York to Philadelphia, we are able to give below the names of his party: H. C. Adams, Peru Electric Manufacturing Company, New York, N. Y.; G. A. Annable, Cutter Electric & Manufacturing Company, New York, N. Y.; Thomas H. Bibber, J. L. Kirkland, H. B. Kirkland, Thos. G. Grier and R. R. Corey, American Circular Loom Company; Arthur Bosley, Electric Material Company, Baltimore, Md.; C. A. Benton, Marine Engine and Machine Company, New York, N. Y.; John H. Dale, Dale Manufacturing Company, New York, N. Y.; Avery P. Eckert, Safety Insulated Wire & Cable Company, New York, N. Y.; A. C. Farrand, City Electrician, Atlantic City, N. J.; E. W. Goldschmidt; F. M. Hawkins and W. B. Hall, Pass & Seymour; C. I. Hills; Robt. T. Lozier, Bullock Electric Manufacturing Company; H. G. Issertel and Alex. Henderson, Sprague Electric Company; W. C. Ballda, B. & C. Electric Construction Company, Utica, N. Y.; J. W. McDewell, Manhattan Electric Supply Company, New York, N. Y.; H. E. Monk, Ostrander & Company, New York, N. Y.; J. M. Wakeman, T. C. Martin and George W. Elliott, ELECTRICAL WORLD AND ENGINEER; Mortimer Norden, Norden Bittner Electric Company, New York, N. Y.; G. A. Nisbet, G. I. Company, New York, N. Y.; J. B. Olson, Habirshaw Wires, New York, N. Y.; A. A. Pope, Luther Stieringer and Arthur Williams, New York Edison Company; J. Jones, Jr., J. Jones & Son, New York, N. Y.; Robt. McKean Thomas, Thomas & Betts, New York, N. Y.; W. J. Watson, American Electrical Works, New York, N. Y.; C. L. Eidlitz, Pres. National Electric Contractors' Association, New York, N. Y.; Harry Alexander, New York, N. Y.; Fred Blackall, Blackall & Baldwin, New York, N. Y.; A. J. Martin, Commercial Construction Company, New York, N. Y.; S. Davis, Conduit Wiring Company, New York, N. Y.; Mr. Haviland, Edwards & Company, New York, N. Y.; J. C. Hatzel, Hatzel & Buehler, New York, N. Y.; Geo. W. Russel, Russel & Company, New York, N. Y.; J. R. Strong, Tucker Electric Construction Company, New York, N. Y.; J. D. Van Wagoner, Van Wagoner & Linn, New York, N. Y.; E. S. Keefer, Western Electric Company, New York, N. Y.; J. C. Stearns, Buffalo, N. Y.; W. H. Morton, Johnson & Morton, Utica, N. Y.; F. L. Frost,

Albany, N. Y.; James Hilton, Rodgers & Hilton, Syracuse, N. Y.; J. H. McCarthy, McCarthy Brothers & Ford, Buffalo, N. Y.; H. L. Sackett, Buffalo, N. Y.; Mr. Wilhelm, Wilhelm Telephone Manufacturing Company, Buffalo, N. Y.; H. D. Pierce, Water Valley, N. Y.; F. W. Newman, Albany District Telephone Company; E. G. Bernard, Troy, N. Y.; Messrs. Schmidt, Horton, Whipple, Jennings, Peacock, Crowley, Hall and Kingston, all of Rochester, N. Y.; E. E. Newbury, St. Louis, Mo.; Frank J. Miner, Seidler-Miner Electric Company, Detroit, Mich.; Mr. Sutter; Mr. Andrews; Frank Stout, I. P. Frink & Company, New York, N. Y.; Mr. Luckhurst; J. F. Burns, Schenectady, N. Y.; C. E. Corrigan, Osburn Conduit Company, New York, N. Y.; H. C. Roberts, H. C. Roberts Electrical Supply Company, Philadelphia, Pa.; Messrs. Dolbier and Coster, Walker & Kepler; Thos. H. Townsend, Vallee Brothers Electric Company; Mr. Keller, Keller, Pike & Company, Philadelphia, Pa.; Mr. Boyd, Baltimore, Md.; Mr. Gray, Minneapolis, Minn.; Judge McCleary, Detroit, Mich.

NEW INDUSTRIAL COMPANIES.

THE RAILWAY AND ELECTRIC SUPPLY COMPANY has been formed; capital, $50,000. Directors: H. M. Shaw, East Orange; E. E. Shaw, G. C. Moon, New York.

THE EASTERN INSULATION COMPANY, formed at Newark, N. J., will manufacture wire insulation; capital stock $100,000; incorporators, Robert W. Taylor, Rudolph Brummeshop, Louis P. St. Clair.

AUTOMATIC CALLS.—The Wilson Automatic Bell Call and Fire Alarm Company has been incorporated at Buffalo; capital, $100,000. Directors: Edward J. Bowen, L. E. Haynes and F. S. Parker, Buffalo.

THE LAGONDA MANUFACTURING COMPANY, of Springfield, Ohio, has been incorporated by H. C. Wineland, J. W. Gunn, C. Pence, and Baldwin McGrew to manufacture boiler cleaners, tools, supplies and steam specialties. Capital stock $10,000.

THE POMEROY MOTOR VEHICLE COMPANY, of Brooklyn, has been chartered by the Secretary of State. The capital stock is $120,000. The directors of the company for the first year are as follows: Bernard H. Pomeroy, James L. Lazelle and Charles D. Winfield, of Brooklyn.

THE GENERAL ENGINEERING & CONSTRUCTION COMPANY recently organized at Akron, Ohio, with R. T. Nailer, president, C. J. Brunner, vice-president, and J. E. Leighton, secretary-treasurer, will do electrical construction work and manufacture electric tram cars and outfits for industrial equipments.

CLARK WIRELESS TELEGRAPH CO.—Articles of incorporation of the Thos. E. Clark Wireless Telegraph-Telephone Company have been filed at Lansing, Mich. The capital stock is $250,000, of which $150,000 is paid in and the shareholders are Thomas E. Clark, $50,000; John Hubbard, $25,000; Thomas F. Ahern, $25,000 Thomas E. Clark, trustee, $75,000; John Hubbard, trustee, $25,000; Thomas F. Ahern, trustee, $50,000. The company has bought out all Clark's patents, and the instruments and equipments worked under Clark's patents in Detroit by the American Engineering Co. and these have been turned over. This new organization will be a parent concern, doing business after the plan adopted by the Bell Telephone Company in forming subsidiary companies to control certain districts.

LEGAL.

STORAGE BATTERY SUIT DECIDED.—On July 23, 1902, Judge Kohlsaat, at Chicago, dissolved the restraining order granted against the Porter Battery Company of Chicago under suit brought by the Electric Storage Battery Company of Philadelphia. Injunction against the manufacture of the Porter storage battery was denied.

CAR FENDER ORDINANCES.—As to car fenders, a judge has decided that the city council has no right by legislative outhority, either expressed or implied to pass an ordinance requiring a street railway company to place fenders on all its cars. The street railway company refused to obey the ordinance and suit was brought to enforce it.

IMPORTATION OF STORAGE BATTERIES.—Judge Thomas, in the U. S. Circuit Court, New York, has granted a temporary injunction restraining the International Power Company and the Manhattan Transit Company from importing, manufacturing, selling or using any storage batteries made under the Brush patent of 1886, claimed to be owned by the Electric Storage battery Co., and especially the "so-called Fulmen batteries." The defendants are required to show cause on August 6 why the injunction should not be made permanent. The order of the court was served upon Geo. W. Hoadley, treasurer of the International Power Company, and F. W. Curtis, secretary of the Manhattan Transit Company.

Trade Notes.

THE STANDARD ELECTRIC COMPANY, of Erie, Pa., has been incorporated under the laws of Pennsylvania, and has changed its name to that of the Federal Electric Company.

NOME, ALASKA.—The John M. Klein Electrical Works recently shipped fifty telephones to Nome for a new telephone system that will be established there. This house has a great demand for telephones all over the coast for independent companies and private lines.

INDICATING ENCLOSED FUSES.—The Chase-Shawmut Company, Boston, Mass., have issued a circular describing a line of enclosed fuses fitted with the Morse indicator. The fuses are made from single-light size up to a capacity of 500 amperes and for circuits from 125 volts to 2,500 volts.

CLEVELAND, OHIO.—The Brown Hoisting Machine Company has been awarded the contract for the largest of three mammoth cranes to be installed in the new plant of the William Todd Company, as Youngstown. It will have a 70-ft. span with 60 tons capacity, and will be electrically driven.

THE GREGORY ELECTRIC COMPANY, Chicago, in a 72-page pamphlet publishes a list of installations which it has supplied with electrical apparatus. The 2,000 or more names in this list make the pamphlet a useful reference list to central stations and isolated plants. Every State in the Union appears to be represented, and also several foreign countries.

ELECTRICITY IN CEMENT WORKS.—An interesting article appeared in these pages on July 19, of the use of electricity at the American Alsen Cement Company's Works, West Camps, N. J. We learn that all of the electrical machinery, with the exception of the balancing transformer, was furnished by the Crocker-Wheeler Co., of Ampere, N. J.

STUART-HOWLAND COMPANY, 279-287 Devonshire Street, Boston, report great activity in business. They now have 12 salesmen on the road calling upon the electrical trade throughout the greater part of the United States and Canada. Their foreign trade is also increasing and is quite a factor in their business. They have recently acquired several exclusive Eastern agencies, including that of the Acme time switch.

WARREN, OHIO.—The Sterling Electric Company has elected old directors as follows: W. A. Smith, C. G. Denison, G. C. Webster, Wm. Coale, Washington Hyde, Charles Devoe and G. B. Devoe. Officers: W. A. Smith, president; C. G. Denison, vice-president; G. C. Webster, secretary, and Wm. Coale, treasurer. It was decided to increase the capital stock from $50,000 to $1,000,000. Work on an addition to the plant has been started.

COLUMBUS, OHIO.—John G. Webb and H. A. Fisher, of the Columbus, Delaware & Marion Railway, visited the factory of the Kuhlman Car Company, Cleveland, a few days ago to inspect the new cars being built for the company. They are among the finest cars ever built, being 57 ft. over all, with smoking compartments and all modern improvements. They will be equipped with four 75-hp G. E. motors and with the type N. multiple unit controllers.

WOTTON ELECTRIC & MANUFACTURING COMPANY, of Atlanta, Ga., have recently installed an up-to-date cabinet shop, and are prepared to fill orders promptly for annunciators, etc., in regard to which they have just issued a neat little bulletin, which is now about ready, and which brings out very prominently the features most vital in the manufacture of this important class of apparatus. The condenser is always worth consideration, and copies of another bulletin on it should be also secured.

THE GREEN FUEL ECONOMIZER COMPANY, Mattawan, N. Y., have recently issued a handsome catalogue in octavo size, of about 100 pages, devoted to the Green economizer. A large number of plants are illustrated in which the economizer has been installed, while prospective and diagrammatic details are given of the construction of this well-known apparatus. These are accompanied by numerous testimonials from users. There is also a large amount of technical data, with tables, etc., relative to chimneys and fuel, boiler temperatures, etc. The pamphlet is not only interesting, but valuable, and of the kind that an engineer usually keeps around on his desk.

HARRISBURG ENGINES.—The Harrisburg Foundry & Machine Works, Harrisburg, Pa., has gotten out in unique form a list of Harrisburg engines in use all over the world. The usual book-form of such lists is departed from; in this case the list is given on one slip of paper 22 ft., 10 in. long by 4¼ in. wide, and folded in zig-zag fashion so as to make a pad about 3 in. by 4¼ in. when it is closed up. The list is arranged by States and foreign countries, alphabetically, the names of the concerns operating Harrisburg engines and their location, together with the horse power of the engines being given. The total horse power represented is given as nearly one-half million.

THE GEO. WORTHINGTION COMPANY, 95-103 St. Clair St., Cleveland, Ohio, a well-known and large hardware concern, have issued a very handsome catalogue in paper cover, devoted almost entirely to electrical apparatus and supplies, and known as their electrical catalogue. There are no fewer than 150 pages, all of which are profusely illustrated, while details are given of the apparatus, with prices. The book includes annunciators, electric gas lighters, push-buttons, switches, lamps, cable clips, pulley blocks, conduit, magnetos, electric motors, fuses and fuse blocks, insulated wire and cables, small generators, insulating materials, etc. Several hundred cuts are shown.

ECONOMICAL ELECTRIC LAMP COMPANY, 123 Liberty Street, New York City, have just issued a very neat and interesting little pamphlet entitled, "A Tale of a Turndown," devoted to their ingenious lamp for giving two degrees of light. The lamp screws into an ordinary socket, and when current is on, the amount of light can be changed without touching the bulb. There are two strings with lettered tags; one says "Dim" and the other says "Bright," and each when pulled gives a corresponding illumination. Lamps of several candle powers and voltages are furnished and prices are quoted on large or small quantities. A price list, pamphlet, etc., will be sent on application.

BUYING AN AUTOMOBILE.—A good plan for the beginner at automobiling is to buy a second-hand machine, says *Country Life in America*. There may be good reasons against this; the previous owner may have abused his car, or a new car may have more improvements or conveniences; still, price is an object to many, and good second-hand cars may be had from the manufacturers who have used them for demonstration or similar purposes. A little paint and overhauling will often change a well-worn automobile into a desirable bargain for the prospective automobilist. Again, some owner may desire a larger or more powerful car, in which case he is willing to dispose of his present machine at a reasonable price, and in first-class condition.

PACKARD LAMPS.—The success of the Packard lamp in the last year has been most pronounced, especially among the street railway companies. The

lamps have not only met the requirements, but there has been an actual saving, it is stated, by two of the largest street railway companies in the world in lamp renewals, one of 33⅓ per cent., another of 20 per cent. over previous years, in one case with the same number of lamps and in the other with an increase in the lamps in actual use of about 8 per cent. This success in the street railway line has followed closely upon their success in the manufacture of lamps for commercial service, and is due largely to the policy of the company in sticking to standard lamps and avoiding novelties and freaks. The Electric Appliance Company are selling agents, Chicago.

WALRATH GAS ENGINES.—The demand for Walrath gas engines has become so great that the company has been compelled to enlarge its plant at Marinette several times, and, having reached the limit of its capacity again, they have decided to erect an entirely new plant at Warren, Pa., which is now in course of construction, and which it is expected to be in full operation by the beginning of the year. It is the intention of the company to devleop the engine in large sizes for use on producer gas, and with this end in view has erected at its factory a complete Taylor producer for thoroughly testing their machines. It may be recalled that this engine received the highest award at the Pan-American Exposition. The Eastern agents, the MacKay Engineering Company, also reports the sale of two engines, 125 and 150-hp, for belted service, to the town of Middleboro, Mass., as well as one 20 and one 30-hp engine for Boston parties, in addition to some smaller machines.

THE WORLD'S WORK for August gives a large portion of its pages to the seasonable subject of the whole people at play. A series of strikingly interesting stories and experiences, descriptions of recreation country, articles on striking development of the continental-wide business of vacation-making, all filled with the spirit of the American summer, are written by Walter H. Page, Julian Ralph, Lindsay Denison, Charles F. Holder, E. T. W. Chambers, Arthur Goodrich, W. G. Cuniff and Ray Stevens. And the hundred illustrations which accompany this special feature of the number help the text to bring the reader into the midst of the Great North Woods, the varied New England resorts, by Wisconsin Lakes, over the Rockies, by the shores of Santa Catalina. Besides the usual March of Events and Among the World Workers there are such additional features as Frederick Palmer's fine article about West Point after a Century, illustrated by Frances Benjamin Johnston—a companion article to Commander Wainwright's Naval Academy article in the July number—and an interesting description of How Labor is Organized, by Ray Stannard Baker. Russell Doubleday, who wrote A Gunner Aboard the Yankee, tells of the new 20-hour trains between New York and Chicago—a striking chapter in American progress—and O. P. Austin, Chief of the Bureau of Statistics at Washington, discusses the future of the American commercial invasion.

THE EXIDE BATTERY, manufactured by The Electric Storage Battery Company, of Philadelphia, combines, it is claimed, the three necessary features of a commercially successful automobile battery—high capacity, long life and freedom from structural weakness. A phenomenally high mileage capacity does not at all imply a commercially successful battery, as the increase in their maintenance cost far outweighs the advantages thus gained. The Exide battery is the result of a most careful series of tests made by The Electric Storage Battery Company in the operation of vehicles by the New York Transportation Company, which after a year or more of continuous service with seventy-five sets of the Exide decided that these batteries provided a sufficient mileage capacity for all classes of service, together with a cost of operation, including maintenance, which is reasonable. Runs of over sixty miles have been frequently made and a conservative estimate of the life of these cells is placed at 6,000 miles. An interesting statement is made by an engineer who has had under his personal observation hundreds of electrical vehicles in daily service to the effect that the Exide Battery is "better adapted to its work than some other portions of the equipment and in point of maintenance cost, is a smaller factor in the total expense than are, for instance, the rubber tires on the vehicle it runs."

Record of Electrical Patents.

UNITED STATES PATENTS ISSUED JULY 22, 1902.

[Conducted by Wm. Rosenbaum, Patent Attorney, 140 Nassau St., N. Y.]

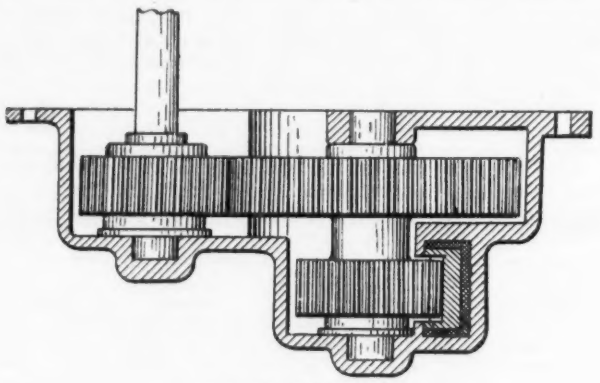
705,016. TRAIN CONTROL SYSTEM; C. E. Barry, Schenectady, N. Y. App. filed Dec. 16, 1898.

705,028. CAR BRAKE; A. Mroluska, Detroit, Mich. App. filed May 12, 1902. A frame under the platform of the car contains gearing interposed between the brake staff and the brake rigging.

705,049. CAR TRUCK; H. A. Dorner, Logansport, Ind. App. filed Nov. 18, 1901. Details.

705,056. TONGUE SWITCH; G. M. Ervin, Johnstown, Pa. App. filed Nov. 13, 1901. The seat for the point of the tongue and also the head of the adjacent main-rail are formed by a separate wear-plate of extra hard metal, which can be removed and replaced.

705,057. RAILWAY TRACK STRUCTURE; G. M. Erving, Johnstown, Pa.



705,028. Car Brake.

App. filed Nov. 13, 1901. A construction whereby the harder sections of the crossover switch or other track structure can be easily removed and replaced.

705,073. DEVICE FOR PREVENTING HUMMING OF TELEPHONE WIRES; M. Grover, Bidwell, Ohio. App. filed Sept. 6, 1901. (See page 175.)

705,075. CAR SEAT; H. S. Hale, Philadelphia, Pa. App. filed April 2, 1902. A pedestal for a car seat consisting of two plates secured together at their side edges, one being flat and the other bulging.

705,076. MANUFACTURE OF CARBON ELECTRODES; C. M. Hall, Niagara Falls, N. Y. App. filed Oct. 19,1902.

705,082. SURFACE CONTACT ELECTRIC RAILWAY; E. M. Hewlett, Schenectady, N. Y. App. filed Oct. 20, 1897.

705,083. ELECTRIC RAILWAY; F. W. Hild and S. B. Stewart, Jr., Schnectady, N. Y. App. filed Nov. 30, 1900.

705,092. SUPERVISORY RELAY; W. Kaisling, Chicago, Ill. App. filed Feb. 4, 1901. (See page 175.)

705,131. RAILWAY TRACK STRUCTURE; J. H. Pflieger, Johnstown, Pa. App. filed Nov. 19, 1901. The wear-plate is provided with lugs extending outward and engaging with portions of the structure and being secured thereto by means of keys or wedges.

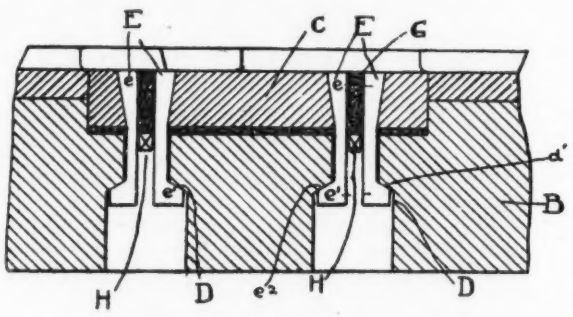
705,136. ELECTROMAGNETIC SWITCH FOR SURFACE CONTACT ELECTRIC RAILWAY SYSTEMS; W. B. Potter, Schenectady, N. Y. App. filed Oct. 11, 1897.

705,137. ELECTRIC SWITCH; W. B. Potter, Schenectady, N. Y. App. filed July 27, 1900. Renewed April 23, 1902.

705,138. BLOW-OUT MAGNET; W. B. Potter, Schenectady, N. Y. App. filed Feb. 28, 1901. Renewed April 23, 1902.

705,150. STREET CAR FENDER; H. J. Schuldt, St. Paul, Minn. App. filed Nov. 25, 1901. A pair of toggle levers for supporting the fender are combined with a trip and resetting device controlled by a plunger which the motorman can operate with his foot.

705,164. RAILWAY SWITCH; A. G. Turcotte, Holyoke, Mass. App. filed Jan. 27, 1902. A projection from the car co-operates with cetain mechanism in the roadbed for throwing the switch.



705,057. Railway Track Structure.

705,179. PUSH POLE; H. Wehler, Harrisburg, Pa. App. filed May 15, 1902. A push-pole, the body portion of which is tubular and formed of a series of metal strips bolted or riveted together, and heads secured to the opposite ends of the pole.

705,299. ADJUSTABLE BRAKE HEAD; G. P. Ritter, Chicago, Ill. App. filed May 15, 1902. The brake head has a journal opening for a journal on the end of the brake beam and a friction strap is secured to the head and adapted to grip the journal end of the brake beam to hold it at any point of adjustment.

705,358. TRUCK BOLSTER; H. R. Keithley, Buffalo, N. Y. App. filed April 11, 1902. Upper Z-bars arranged with their webs vertically and lower Z-bars arranged with their webs vertically, the flanges of the bars being superposed at the ends of the bolster.

705,456. IRIDESCENT COATING OF COPPER, BRONZE, OR LIKE SURFACES; Duncan Sinclair, Coalbrookdale, Eng. App. filed Dec. 31, 1900.

705,466. STREET CAR FENDER; O. Spillern-Spitzer, Brunnersdorf, Kaaden, Austria-Hungary. App. filed April 5, 1902. A pivoted frame suspended horizontally below the car body and carrying strong brushes at its forward end, which can be let down when desired by the motorman.